PATENT ABSTRACTS OF JAPAN

(11)Publication number : 2001-051070
(43)Date of publication of application : 23.02.2001

(51)Int.Cl. G04B 9/00
G04B 17/00
G04C 3/00
H02P 9/00

(21)Application number : 11-227458
(22)Date of filing : 11.08.1999

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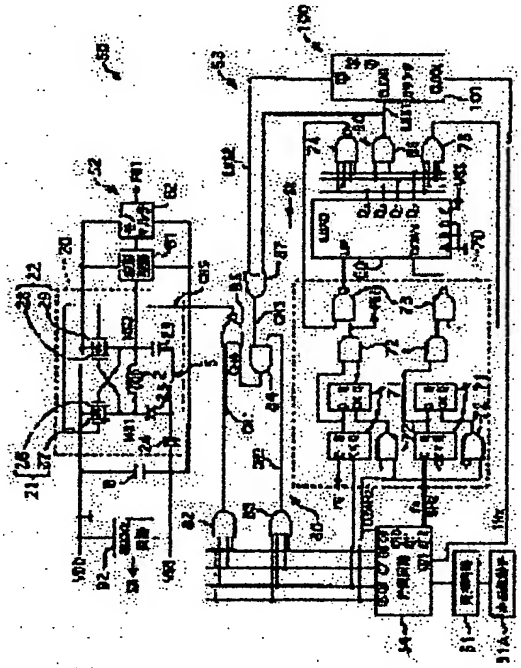
(54) ELECTRONIC CONTROL TYPE MECHANICAL CLOCK AND ITS CONTROL METHOD

(57)Abstract:
PROBLEM TO BE SOLVED: To provide an electronic control type mechanical clock capable of reporting a user on a time delay and preventing the user from using a clock while time is being delayed.
SOLUTION: The electronic control type mechanical clock is provided with a rotary control device 50 for controlling the rotary period of a generator 2 for transducing a mechanical energy from a spring 1 to an electrical energy. The device 50 is provided with an up/down counter 60 for comparing the rotary period of the generator 2 with a reference period, a brake signal generation means 90 for regulating speed that outputs an H-level brake signal LBS1 (brake signal for regulating speed) when the value of the up/down counter 60 is equal to or more than 12 (when the rotary period becomes faster than the reference period), and a brake signal generation means 100 for stopping the movement of clock hands that outputs an H-level brake signal LBS2 (brake signal for stopping the movement of clock hands) when a state where no brake signals for regulating speed are outputted at least four seconds.



LEGAL STATUS

[Date of request for examination] 07.03.2003

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]

[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's decision of rejection]

[Date of extinction of right]

JP2001-51070A

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[The technical field to which invention belongs] This invention relates to an electronics control type machine clock and its control method. It is related with the electronics-control type machine clock equipped with the source of mechanical energy, the indicator driven by said source of mechanical energy, the generator which drives by said source of mechanical energy, generates induction power, and supplies electric energy, a brake means apply brakes to said generator, and the roll control equipment which drives by said electric energy and controls the rotation period of said generator through said brake means in detail, and its control method.

[0002]

[Background of the Invention] The electronics control type machine clock which drives correctly the indicator fixed to **** and displays time of day correctly is known by controlling the current value which mechanical energy in case a spiral spring opens is changed into electric energy with a generator, and roll control equipment is operated by the electric energy, and flows in the coil of a generator.

[0003] By such electronics control type machine clock, the torque (mechanical energy) added to a generator by the spiral spring is set up so that an indicator may be rotated more quickly than reference speed, and it is governing the rotation speed by applying brakes with roll control equipment.

[0004]

[Problem(s) to be Solved by the Invention] However, when a spiral spring comes loose, the spring force of a spiral spring declines and the running torque of a generator is no longer obtained fully, the rotation speed of a generator falls, and movement also becomes a low speed and will continue being in time of day over long duration.

[0005] Under the present circumstances, in spite of having not carried out a right time stamp only by seeing for a moment in order that a user might check time of day since movement was continued, although it is a low speed, the user had the problem of taking for carrying out normal actuation.

[0006] The purpose of this invention can tell a user about time-of-day delay, and is to offer the electronics control type machine clock which can prevent that a user uses a clock while he has been time-of-day delay, and its control method.

[0007]

[Means for Solving the Problem] An indicator which drives an electronics control type machine clock of this invention by source of mechanical energy, and said source of mechanical energy, A generator which drives by said source of mechanical energy, generates induction power, and supplies electric energy, In an electronics control type machine clock equipped with a brake means to apply brakes to said generator, and roll control equipment which drives by said electric energy and controls a rotation period of said generator through said brake means A rotation period detection means by which said roll control equipment detects a rotation period of said generator, It is characterized by including a brake signal generation means for a movement halt to output a brake signal for a movement halt which applies brakes for a movement halt to said generator to said brake means a condition [a rotation period of a generator detected with said rotation period detection means having become beyond the set point].

[0008] According to this configuration, if a rotation period of a generator becomes beyond the set point, a brake signal for a movement halt which applies brakes for a movement halt will be outputted to a generator from a brake signal generation means for a movement halt. Then, brake control for a movement halt in a generator is performed by brake means.

[0009] Applying brakes to a generator is continued or, specifically, the hand is moved by brake control for this movement halt by a halt or applying brakes intermittently, in order to make it a low speed very much. Thereby, a halt or since it becomes a low speed very much, when movement checks an indicator by looking for a time-of-day check of a user, it can recognize abnormalities of movement and can tell a user about time-of-day delay. Therefore, with time-of-day delay, a user can prevent using a clock, can demand actuation which winds up a spiral spring from a user, and can return an electronics control type machine clock to normal actuation.

[0010] Moreover, an indicator which drives an electronics control type machine clock of this invention by source of mechanical energy, and said source of mechanical energy, A generator which drives by said source of mechanical energy, generates induction power,

and supplies electric energy, In an electronics control type machine clock equipped with a brake means to apply brakes to said generator, and roll control equipment which drives by said electric energy and controls a rotation period of said generator through said brake means A rotation period detection means by which said roll control equipment detects a rotation period of said generator, A comparison means to compare a rotation period and a criteria period of said generator, and a brake signal generation means for governing to output a brake signal for governing to said brake means when it is detected that said rotation period became with this comparison means earlier than a criteria period, It is characterized by including a brake signal generation means for a movement halt to output a brake signal for a movement halt which applies brakes for a movement halt to said generator to said brake means a condition [the condition that said brake signal for governing was not outputted having continued beyond the setup time].

[0011] According to this configuration, when a rotation period of a generator becomes earlier than a criteria period, a brake signal for governing is outputted to a brake means, and brake control for governing is performed. Therefore, if a rotation period of a generator becomes [mechanical energy from sources of mechanical energy, such as a spiral spring,] large earlier than a criteria period, brake control for governing will be performed and a rotation period will be returned to a criteria period.

[0012] If it is small and mechanical energy from sources of mechanical energy, such as a condition which does not have a rotation period of a generator earlier than a criteria period, i.e., a spiral spring etc., becomes [a rotation period of a generator] later than a criteria period, since brake control for governing will not be performed on the other hand, a rotation period is returned to a criteria period.

[0013] If a condition, i.e., the condition that a brake signal for governing is not outputted, that brake control for this governing is not performed continues beyond the setup time, a brake signal for a movement halt will be outputted to a brake means, and brake control for a movement halt will be performed. Thereby, a halt or since it becomes a low speed very much, when movement checks an indicator by looking for a time-of-day check of a user, it can recognize abnormalities of movement and can tell a user about time-of-day delay. Therefore, with time-of-day delay, a user can prevent using a clock, can demand actuation which winds up a spiral spring from a user, and can return an electronics control type machine clock to normal actuation.

[0014] In this case, as for said brake signal generation means for a movement halt, it is desirable to output a brake signal for a movement halt which applies brakes for a movement halt to said generator to said brake means a condition [the condition that

said brake signal for governing was not outputted having continued more than for at least 2 seconds].

[0015] If it does in this way, since a brake signal for a movement halt will be outputted a condition [a condition, i.e., the condition that brake control for governing is not performed, that a brake signal for governing was not outputted having continued more than for at least 2 seconds], it can detect certainly that mechanical energy from sources of mechanical energy, such as a spiral spring, became small, and brake control for a movement halt can be performed. In addition, in the condition that a brake signal for governing is not outputted, time amount until it performs brake control for a movement halt has [that what is necessary is just more than for at least 2 seconds] 3 - 4 desirable seconds.

[0016] Furthermore, an indicator which drives an electronics control type machine clock of this invention by source of mechanical energy, and said source of mechanical energy, A generator which drives by said source of mechanical energy, generates induction power, and supplies electric energy, In an electronics control type machine clock equipped with a brake means to apply brakes to said generator, and roll control equipment which drives by said electric energy and controls a rotation period of said generator through said brake means A rotation period detection means by which said roll control equipment detects a rotation period of said generator, A comparison means to compare a rotation period and a criteria period of said generator, and a brake signal generation means for governing to output a brake signal for governing to said brake means when it is detected that said rotation period became with this comparison means earlier than a criteria period, It is contingent [on at least one condition having continued beyond the setup time, while in the condition that a condition beyond a reference value and said brake signal for governing are not outputted for a rotation period of a generator detected with said rotation period detection means]. It is characterized by including a brake signal generation means for a movement halt to output a brake signal for a movement halt which applies brakes for a movement halt to said generator to said brake means.

[0017] According to this configuration, a rotation period of a generator A condition beyond a reference value, or to a condition that a brake signal for governing is not outputted, and a pan Since a brake signal for a movement halt was made to be outputted a condition [these two conditions having continued beyond the setup time], it detects more certainly that mechanical energy from sources of mechanical energy, such as a spiral spring, became small. Brake control for a movement halt can be performed correctly.

[0018] As for said brake signal generation means for a movement halt, in the above configuration, it is desirable to continue at least 2 seconds or more, and to output said brake signal for a movement halt.

[0019] Since it will continue at least 2 seconds or more to a generator and brake control for a movement halt will be performed when mechanical energy from sources of mechanical energy, such as a spiral spring, becomes small if it does in this way, an indicator changes into an abbreviation halt or a condition near it. Thereby, when a user checks by looking, it can identify whether it has stopped whether an indicator is moving the hand. In addition, time amount which performs brake control for a movement halt has [that what is necessary is just 2 seconds or more] about 3 - 6 desirable seconds.

[0020] Moreover, as for said brake signal generation means for a movement halt, it is desirable to output said brake signal for a movement halt at intervals of a fixed period.

[0021] If a rotation period of a generator becomes late further as a result of performing brake control since brake control for a movement halt is performed when energy of a source of mechanical energy falls and a rotation period of a generator becomes later than a criteria period, even if it cancels brake control, movement speed will not rise.

[0022] Therefore, while being able to identify whether it has stopped whether an indicator is moving the hand when a user checks by looking if it is made to perform brake control for a movement halt at intervals of a fixed period Since there is a period of which a brake is canceled even when a user notices an indicator a halt and performs time-of-day doubling actuation of an indicator and winding-up actuation of a spiral spring, the time-of-day doubling actuation and winding-up actuation can be performed smoothly, and operability can be made good. And since it is not necessary to be a special brake discharge actuation means, cost reduction can be measured.

[0023] An indicator which drives a control method of an electronics control type machine clock of this invention by source of mechanical energy, and said source of mechanical energy, A generator which drives by said source of mechanical energy, generates induction power, and supplies electric energy, In a control method of an electronics control type machine clock equipped with a brake means to apply brakes to said generator, and roll control equipment which drives by said electric energy and controls a rotation period of said generator through said brake means It is characterized by outputting a brake signal for a movement halt which applies brakes for a movement halt to said generator to said brake means a condition [having detected a rotation period of said generator and a rotation period of a detected generator having become beyond the set point].

[0024] Moreover, a control method of an electronics control type machine clock of this

invention A source of mechanical energy, and an indicator driven by said source of mechanical energy, A generator which drives by said source of mechanical energy, generates induction power, and supplies electric energy, In a control method of an electronics control type machine clock equipped with a brake means to apply brakes to said generator, and roll control equipment which drives by said electric energy and controls a rotation period of said generator through said brake means When a rotation period of said generator is detected, a rotation period and a criteria period of a generator which were detected are compared and a rotation period becomes earlier than a criteria period, while outputting a brake signal for governing to said brake means It is characterized by outputting a brake signal for a movement halt which applies brakes for a movement halt to said generator to said brake means a condition [the condition that said brake signal for governing was not outputted having continued beyond the setup time].

[0025] In this case, it is desirable to output a brake signal for a movement halt which applies brakes to said generator to said brake means a condition [the condition that said brake signal for governing was not outputted having continued more than for at least 2 seconds].

[0026] Furthermore, a control method of an electronics control type machine clock of this invention A source of mechanical energy, and an indicator driven by said source of mechanical energy, A generator which drives by said source of mechanical energy, generates induction power, and supplies electric energy, In an electronics control type machine clock equipped with a brake means to apply brakes to said generator, and roll control equipment which drives by said electric energy and controls a rotation period of said generator through said brake means When a rotation period of said generator is detected, a rotation period and a criteria period of a generator which were detected are compared and a rotation period becomes earlier than a criteria period, while outputting a brake signal for governing to said brake means It is contingent [on at least one condition having continued beyond the setup time, while in the condition that a condition beyond a reference value and said brake signal for governing are not outputted for a rotation period of a detected generator]. It is characterized by outputting a brake signal for a movement halt which applies brakes for a movement halt to said generator to said brake means.

[0027] When an indicator is checked by looking for the same effect as an effect stated by electronics control type machine clock mentioned above, i.e., a time-of-day check of a user, according to these configurations, abnormalities of movement can be recognized and a user can be told about time-of-day delay. Therefore, with time-of-day delay, a user

can prevent using a clock, can demand actuation which winds up a spiral spring from a user, and can return an electronics control type machine clock to normal actuation.

[0028]

[Embodiment of the Invention] Below, the operation gestalt of this invention is explained based on a drawing.

[0029] (The 1st operation gestalt) The block diagram showing the electronics control type machine clock of the 1st operation gestalt of this invention is shown in drawing 1 .

[0030] The electronics control type machine clock is equipped with the indicator 4 for time stamps which connects with accelerating **** 3 and accelerating **** 3 as energy transfer equipment which transmits the torque of the spiral spring 1 as a source of mechanical energy, and a spiral spring 1 to a generator 2, and is driven with the torque of a spiral spring 1.

[0031] A generator 2 is driven by the spiral spring 1 through accelerating **** 3, generates induction power, and supplies electric energy. Through the rectifier circuit 5 which consists of pressure-up rectification, full wave rectification, half-wave rectification, transistor rectification, etc., it is rectified and charge supply of the ac output from this generator 2 is carried out in a pressure up and the power circuit 6 which consisted of capacitors etc.

[0032] In addition, with this operation gestalt, as shown also in drawing 2 , the brake circuit 20 as a brake means including a rectifier circuit 5 is provided in the generator 2. The 1st switch 21 connected to the 1st alternating current input terminal MG 1 into which the AC signal (alternating current) by which this brake circuit 20 was generated with the generator 2 is inputted, By having the 2nd switch 22 connected to the 2nd alternating current input terminal MG 2 into which said AC signal is inputted, and turning on these switches 21 and 22 in coincidence The 1st and 2nd alternating current input terminal MG1 and MG2 is short-circuited, it changes into a closed-loop condition, and short brakes are applied.

[0033] The 1st field effect transistor (FET) 26 of Pch by which the gate was connected to the 2nd alternating current input terminal MG 2, and the 2nd field effect transistor 27 as which the chopper signal (chopper pulse) CH5 from the chopper signal generator 80 mentioned later is inputted into the gate are connected to juxtaposition, and the 1st switch 21 is constituted.

[0034] The 3rd field effect transistor (FET) 28 of Pch by which the gate was connected to the 1st alternating current input terminal MG 1, and the 4th field effect transistor 29 as which the chopper signal CH5 from the chopper signal generator 80 is inputted into the gate are connected to juxtaposition, and the 2nd switch 22 is constituted.

[0035] It has the capacitor 23 for pressure ups connected to the generator 2, diodes 24 and 25, and switches 21 and 22, and the voltage doubler rectifier circuit 5 is constituted. In addition, as diodes 24 and 25, while passing current to an one direction, the class is not asked that what is necessary is just a tropism element. It is desirable to use a Schottky barrier diode and silicon diode with small descent voltage Vf and reverse leakage current as diodes 24 and 25 by the electronics control type machine clock, especially, since the electromotive voltage of a generator 2 is small. And the direct current signal rectified in this rectifier circuit 5 is charged in a power circuit (capacitor) 6.

[0036] Said brake circuit 20 is controlled by the roll control equipment 50 driven with the power supplied from a power circuit 6.

[0037] It has an oscillator circuit 51, the rotation detector 52 as a rotation period detection means, and a control circuit 53, and roll control equipment 50 is constituted, as shown also in drawing 1 .

[0038] An oscillator circuit 51 outputs an oscillation signal (32768Hz) using quartz-resonator 51A which is a source of a time amount standard, and dividing of this oscillation signal is carried out to a certain fixed period by the frequency divider 54 which consists of 15 steps of flip-flops. The 12th step of output Q12 of a frequency divider 54 is outputted as a 8Hz reference signal fs.

[0039] The rotation detector 52 consists of the waveform shaping circuits 61 and the mono-multivibrators 62 which were connected to the generator 2. A waveform shaping circuit 61 consists of amplifier and a comparator, and changes a sine wave into a square wave. The mono-multivibrator 62 functions as a band pass filter which passes only the pulse below a certain period, and outputs the rotation detecting signal FG1 which removed the noise.

[0040] The control circuit 53 is equipped with the updown counter 60, the brake signal generation means 90 for governing, the brake signal generation means 100 for a movement halt, and the chopper signal generator 80 as a comparison means by which the rotation detecting signal FG1 of the rotation detector 52 and the reference signal fs from a frequency divider 54 are inputted through a synchronous circuit 70 and this synchronous circuit 70.

[0041] The synchronous circuit 70 is adjusted so that each of these signal pulses may lap and may not be outputted, while consisting of four flip-flops 71, the AND gate 72, and NAND gate 73 and synchronizing the rotation detecting signal FG1 with a reference signal fs (8Hz) using the signal of the 5th step of output Q5 (1024Hz) of a frequency divider 54, or the 6th step of output Q6 (512Hz).

[0042] The updown counter 60 consists of 4-bit counters. The signal based on said rotation detecting signal FG1 in the rise count input of an updown counter 60 is inputted from a synchronous circuit 70, and the signal based on said reference signal fs in a down count input is inputted from a synchronous circuit 70. Thereby, counting and calculation of a difference of a reference signal fs and the rotation detecting signal FG1 can carry out now to coincidence.

[0043] In addition, four data input terminal (presetting terminal) A-D is prepared in this updown counter 60, and the initial preset value (initial counter value) of an updown counter 60 is set as "11" in H level signal being inputted into Terminals A, B, and D.

[0044] Moreover, the system-reset signal SR from the initialization circuit 92 connected to the power circuit 6 is inputted into the LOAD input terminal of an updown counter 60. In addition, if the signal of H level is outputted and it becomes more than predetermined voltage until the charge voltage of a power circuit 6 turns into predetermined voltage, the initialization circuit 92 consists of these operation gestalten so that the signal of L level may be outputted.

[0045] In order that an updown counter 60 may not receive an up-and-down input until the system-reset signal SR is canceled until a LOAD input is set to L level that is, the counter value of an updown counter 60 is maintained by "11."

[0046] The updown counter 60 has 4-bit output QA-QD. Therefore, with [a counter value] "12", both 3 and the outputs QC and QD of the 4th bit output H level signal, but with [a counter value] "11", neither 3 nor the outputs QC and QD of the 4th bit output H level signal. [more than] [below] These outputs QC and QD are inputted into the brake signal generation means 90 for governing.

[0047] In addition, each output of NAND gate 74 where output QA-QD was inputted, and the OR gate 75 is inputted into said NAND gate 73, respectively. If it follows, for example, two or more inputs of a rise count signal continue and a counter value is set to "15", even if L level signal will be outputted from NAND gate 74 and a rise count signal will be further inputted into NAND gate 73, the input is set up so that it may be canceled and a rise count signal may not be inputted into an updown counter 60 any more. If a counter value is set to "0", since similarly L level signal will be outputted from the OR gate 75, the input of a down count signal is canceled. Thereby, it is set up so that it may not be set to "0" or a counter value may not be set to "15" more than "0" more than "15."

[0048] The brake signal generation means 90 for governing is constituted by the AND gate 86 which outputs the brake signal LBS1 using the outputs QC and QD of an updown counter 60. That is, a counter value is outputted above "12" and the brake

signal LBS1 of L level is outputted [the counted value of an updown counter 60] for the brake signal LBS1 (brake signal for governing) of H level from the AND gate 86 below by "11" from the AND gate 86, respectively.

[0049] The brake signal generation means 100 for a movement halt is constituted by the counter 101 which connected the output of said AND gate 86 to the clear input terminal. The 15th step of output Q15 (1Hz) of said frequency divider 54 is connected to the clock input terminal of a counter 101. Therefore, if the counted value of an updown counter 60 becomes below "11", reset will stop a counter 101 requiring, the brake signal LBS2 (brake signal for a movement halt) of H level will be outputted from an output terminal Q3 after 3 - 4 seconds, and H level and L level will specifically be repeated in a cycle of 4 seconds 1 fixed cycle. In addition, the brake signals LBS1 and LBS2 are both inputted into the chopper signal generator 80 through the OR gate 87.

[0050] The AND gate 82 where the chopper signal generator 80 outputs the 1st chopper signal CH1 using the outputs Q5-Q8 of a frequency divider 54, The OR gate 83 which outputs the 2nd chopper signal CH2 using the outputs Q5-Q8 of a frequency divider 54, It has the NOR gate 85 where the AND gate 84 where the output CH3 of said OR gate 87 and the 2nd chopper signal CH2 are inputted, and the output CH4 of this AND gate 84 and the 1st chopper signal CH1 are inputted.

[0051] The output CH5 from the NOR gate 85 is inputted into the gate of the Pch transistors 27 and 29. While the output CH5 serves as L level, it is maintained by the ON state, a generator 2 short-circuits, and transistors 27 and 29 require a brake. On the other hand, while the output CH5 serves as H level, transistors 27 and 29 are maintained by the OFF state and a brake does not start a generator 2. Therefore, chopper ring control of the generator 2 can be carried out with the output CH5 from the NOR gate 85.

[0052] Here, the duty ratio of each of said chopper signals CH1 and CH2 is the ratio of the time amount which has applied brakes to the generator 2 among one period of the chopper signal, and is the ratio of the time amount which serves as H level among one period in each chopper signals CH1 and CH2 with this operation gestalt. For example, the duty ratio of each chopper signals CH1 and CH2 is set up as shown in drawing 3 .

[0053] Now, when the output CH3 from the NOR gate 87 is L level signal, an output CH4 also serves as L level (when both the brake signals LBS1 and LBS2 are L level). For this reason, the chopper signal which the chopper signal CH1 reversed of the output CH5 from the NOR gate 85, i.e., H level period, (brake-off period) is as long as 15/16, and L level period (brake "on" period) serves as 1/16 and a chopper signal with the small (1/16) duty ratio (ratio which turns on switches 21 and 22) which is short, that is,

performs weak brake control. Therefore, to a generator 2, weak brake control which gave priority to the generation-of-electrical-energy force is performed.

[0054] On the other hand, when the output CH3 from the NOR gate 87 is H level signal, from the AND gate 84, the chopper signal CH2 is outputted as it is (when either of the brake signals LBS1 and LBS2 is H level), and an output CH4 becomes the same as that of the chopper signal CH2. For this reason, the chopper signal which reversed the output CH2 of the output CH5 from the NOR gate 85, i.e., H level period, (brake-off period) is as short as 1/16, and L level period (brake "on" period) serves as 15/16 and a chopper signal with the big (15/16) duty ratio which is long, that is, performs strong brake control. Therefore, an output CH5 can improve damping torque, chopper ring control being performed and suppressing the fall of generated output, since it becomes H level signal a fixed period and a short brake is turned off, although the total time amount of L level signal which applies short brakes to a generator 2 becomes long and strong brake control is performed to a generator 2.

[0055] Therefore, strong brake control according [the output CH3 from the NOR gate 87] to a chopper signal with a big duty ratio is performed between H level signals, and weak brake control by the chopper signal with a small duty ratio is performed between L level signals. That is, strong brake control and weak brake control are changed by the output CH3 from the NOR gate 87.

[0056] In addition, in this invention, a strong brake and a weak brake are relative, and a strong brake means that a brake force is strong compared with a weak brake. What is necessary is just to set up suitably the duty ratio and frequency of the concrete brake force in each brake, i.e., a ** chopper brake signal, in operation.

[0057] Next, the actuation in this operation gestalt is explained with reference to the timing chart of drawing 4 and drawing 5 .

[0058] If a generator 2 begins to operate and the system-reset signal SR of L level is inputted into the LOAD input of an updown counter 60 from the initialization circuit 92, as shown in drawing 4 , the rise count signal based on the rotation detecting signal FG1 and the down count signal based on a reference signal fs will count by the updown counter 60. Each of these signals are set up so that it may not be inputted into a counter 60 by the synchronous circuit 70 at coincidence.

[0059] For this reason, if a rise count signal is inputted, a counter value will be set to "12" and the brake signal LBS1 from the AND gate 86 will turn into H level signal from the condition that initial counted value is set as "11." Since the brake signal LBS2 from the outgoing end Q3 of the brake signal generation means 100 (counter 101) for a movement halt is still L level at this time, the brake signal LBS1 is outputted as it is,

and, as for the output CH3 from the OR gate 87, brake control for governing is performed by the brake circuit 20 to a generator 2. And with [a counter value] "12", the brake control for governing is continued. [more than]

[0060] On the contrary, if a down count signal is inputted and a counter value becomes below "11", the brake signal LBS1 will serve as L level. Since the brake signal LBS2 from the outgoing end Q3 of a counter 101 is still L level, the output CH3 from the OR gate 87 is L level until this condition passes for 3 to 4 seconds at this time. For this reason, the output CH5 from the NOR gate 85 The chopper signal which the chopper signal CH1 reversed, i.e., H level period, (brake-off period) is as long as 15/16. Since L level period (brake "on" period) serves as 1/16 and a chopper signal with the small (1/16) duty ratio (ratio which turns on switches 21 and 22) which is short, that is, performs weak brake control, to a generator 2, weak brake control which gave priority to the generation-of-electrical-energy force is performed.

[0061] Thus, if it controls, as shown in drawing 4 , a rise counter signal and a down counter signal will be inputted by turns, and a counter value will shift to the lock condition which repeats "12" and "11." As a result of repeating strong brake control and weak brake control according to a counter value in this case, a generator 2 is maintained near the set-up rotation speed.

[0062] On the other hand, since a counter value is [the brake signal LBS1] L level in the condition below "11", a counter 101 is in the condition that reset does not start. Since the 15th step of output Q15 (1Hz) of a frequency divider 54 is inputted into the clock input terminal of a counter 101, as shown in drawing 5 , the brake signal LBS2 (brake signal for a movement halt) of H level is outputted from an output terminal Q3 after the 3 - 4 seconds, and it is stopped after 4 seconds. Then, the brake signal LBS2 (brake signal for a movement halt) is outputted after 4 seconds, and this is repeated. Since the brake signal LBS1 is still L level at this time, the brake signal LBS2 is outputted as it is, and, as for the output CH3 from the OR gate 87, brake control for a movement halt is performed by the brake circuit 20 to a generator 2. That is, since movement changes into the condition near a halt or it as a result of performing brake control for a movement halt for 4 seconds and repeating it in a cycle of 4 seconds, in case a user checks time of day, the abnormalities in movement can be recognized easily and certainly.

[0063] The flow chart of drawing 6 explains the above actuation.

[0064] In step (it omits Following ST) 1, it judges whether it is brake control for governing. While performing brake control for governing with [the counter value of the uptown counter 60] "12", [more than] Both the timer 1 (timer which measures the

brake signal OFF time amount for a movement halt), and the timer 2 (timer which measures the brake signal ON time amount for a movement halt) are reset by ST2. Then, after setting to F= 0 a flag (flag which memorizes ON of the brake signal for a movement halt, and an OFF condition) by ST3, the processing which returns to ST1 is repeated.

[0065] In decision of ST1, with [the counter value of the uptown counter 60] "11", it progresses to ST4 and judges whether it is flag F-1. [below] If it is not flag F-1 (condition of OFF of the brake signal for a movement halt) and is, it will judge whether it progressed to ST5 and the timer 1 passed for 3 seconds. A counter value is below "11", and if the condition that it is not flag F-1 passes for 3 seconds, the brake signal for a movement halt is started by ST6, and it considers as F-1 by ST7, and after starting a timer 2 by ST8, it will return to ST1.

[0066] Then, since it is recognized in ST4 that it is F-1, it judges whether it progressed to ST9 and the timer 2 passed for 4 seconds. If a counter value is below "11" and the condition of flag F-1 passes for 4 seconds, F= 0 and a timer 2 will be reset by ST10, a timer 1 will be reset by ST11, and the brake signal for a movement halt will be stopped by ST12. then, the result by which processing of STs 1, 4-8 and processing of STs 1, 4, 9-12 are repeated -- the brake control for a movement halt -- being periodic (4-second gap) -- it is repeated.

[0067] According to such this operation gestalt, there are the following effects.

[0068] (1) Since the brake signal generation means 100 for a movement halt other than the brake signal generation means 90 (AND gate 86) for governing for performing brake control for the usual governing as roll control equipment 50 was established The torque of a spiral spring 1 falls, the rotation period of a generator 2 becomes late compared with a criteria period, and when movement also becomes slow and deviation produces it in the time stamp of an indicator 4, brake control for a movement halt can be performed to a generator 2. For this reason, when the clock is not moving the hand normally, movement can be recognized, it can be made a low speed very much, and a halt or in case the user of a clock checks time of day, the abnormalities in movement can be recognized easily and certainly, and use of the electronics control type machine clock in the condition of having governed correctly can be urged.

[0069] (2) When the rotation period of a generator 2 becomes earlier than a criteria period, the brake signal for governing (brake signal LBS1 of H level) is outputted to a brake circuit 20, and it is performed, the brake control, i.e., the strong brake control, for governing. Therefore, if the rotation period of a generator 2 becomes [the mechanical energy from a spiral spring 1] large earlier than a criteria period, brake control for

governing will be performed and a rotation period will be returned to a criteria period.
[0070] If it is small and the rotation period of a generator 2 becomes later than a criteria period as for the condition which does not have the rotation period of a generator 2 earlier than a criteria period, i.e., the mechanical energy from a spiral spring 1, weak brake control will be performed. That is, since brake control for governing is not performed, a rotation period is returned to a criteria period.
[0071] Thus, it is maintainable by repeating strong brake control and weak brake control near the rotation speed which had the generator 2 set up.
[0072] (3) the condition that brake control for governing is not performed -- the setup time -- if it continues 3 to 4 seconds or more, the brake signal for a movement halt (brake signal LBS2 of H level) will be outputted to a brake circuit 20, and, specifically, brake control for a movement halt will be performed.
[0073] Therefore, since brake control for a movement halt is performed a condition [the condition that brake control for governing was not performed having continued 3 to 4 seconds or more], it can detect certainly that the mechanical energy from a spiral spring 1 became small, and brake control for a movement halt can be performed.
[0074] (4) In the brake control for a movement halt, since strong brake control during at least 4 seconds is performed, movement changes into the condition certainly near a halt or it. Therefore, when an indicator is checked by looking for a time-of-day check of a user, the abnormalities of movement can be recognized and a user can be told about time-of-day delay. Therefore, with time-of-day delay, a user can prevent using a clock, can demand the actuation which winds up a spiral spring 1 from a user, and can return an electronics control type machine clock to normal actuation.
[0075] (5) If the rotation period of a generator becomes late further as a result of performing brake control since brake control for a movement halt is performed when the energy of a spiral spring 1 falls and the rotation period of a generator 2 becomes later than a criteria period, even if it cancels brake control, movement speed will not rise.
[0076] While being able to identify whether it has stopped whether the indicator is moving the hand with this operation gestalt when a user checks by looking since brake control for a movement halt is performed at intervals of the periods of 4 seconds Since there is a period of which the brake is canceled even when a user notices an indicator 4 a halt and performs time-of-day doubling actuation of an indicator 4 and winding-up actuation of a spiral spring 1, the time-of-day doubling actuation and winding-up actuation can be performed smoothly, and operability can be made good. And since it is not necessary to be a special brake discharge actuation means, cost reduction can be measured.

[0077] (6) A counter value is more than "12", or the brake control for governing is below "11", or since it is set up with a chisel, it does not need to set up a braking time etc. separately, roll control equipment 50 can be made as for it to a simple configuration, and it can reduce components cost and a manufacturing cost, and can offer an electronics control type machine clock cheaply.

[0078] (7) Since the timing into which a rise counter signal is inputted changes according to the rotational speed of a generator 2, the time amount of strong brake control can also be adjusted automatically. For this reason, quick stable control of responsibility can be performed in the state of the lock into which a rise counter signal and a down count signal are inputted especially by turns.

[0079] (8) Since roll control equipment 50 is carrying out brake control of the generator 2 in having the brake circuit 20 which has the transistors 27 and 29 which can short-circuit the both ends of a generator 2, impressing the brake signal which becomes transistors 27 and 29 from a square wave pulse, and turning on and turning off transistors 27 and 29, it can simplify the configuration of a brake circuit 20 and can reduce cost.

[0080] (The 2nd operation gestalt) The important section of the 2nd operation gestalt of this invention is shown in drawing 6 . In addition, in this description of drawing, about a component the same as that of the 1st operation gestalt, or equivalent, the same sign is attached, and the explanation is omitted or simplified.

[0081] With the 2nd operation gestalt, in the 1st operation gestalt, the brake signal generation means 100 for a movement halt is deleted, and the rotation period detection means 110 and the brake signal generation means 120 for a movement halt are established instead of it.

[0082] The rotation period detection means 110 is equipped with six steps of frequency dividers 111 which carry out dividing of the 7th step of output Q7 of said frequency divider 54, the NOR gate 112 which considers the 4th step and the 6th step of outputs F4 and F6 of this frequency divider 111 as an input, the flip-flop 113 which connected the output of this NOR gate 112 to CK input terminal, and the flip-flop 114 which connected Q output terminal of this flip-flop 113 to D input edge. In addition, the output FG2 of the AND gate 72 in said synchronous circuit 70 is inputted into the clear terminal of a frequency divider 111. Moreover, in the flip-flop 113, the signal of H level is inputted into D input edge for the output FG2 of the AND gate 72 in a synchronous circuit 70 in the clear input edge, respectively. Moreover, said rotation detecting signal FG1 is inputted into CK input edge of a flip-flop 114. Therefore, although the rotation period of a generator 2 is [SP1] L level between 156ms or more, the rotation period of a

generator 2 serves as [SP1] H level in less than 156ms.

[0083] The brake signal generation means 120 for a movement halt is equipped with the counter 121 which connected the reversal output of said flip-flop 114 to the clear input terminal, the flip-flop 122 which connected the output terminal Q3 of this counter 121 to CK input terminal, and the AND gate 123 which considers the output from the output terminal Q3 of said counter 121, and the reversal output of a flip-flop 122 as an input. In addition, the output (1Hz) from the output Q15 of said frequency divider 54 is inputted into the clock input terminal of a counter 121. Moreover, the output SP 1 of said flip-flop 114 is carried out at CR inversed input terminal of a flip-flop 122, and the ******** input of the signal of H level is carried out in D input edge.

[0084] Therefore, as for a counter 121, in less than 156ms after the rotation period of a generator 2 is H level, SP1 is reset for it, and the signal of H level is not outputted from an output terminal Q3.

[0085] However, if the rotation period of a generator 2 is set to 156ms or more, as shown in drawing 8 , SP1 is set to L level and a counter 121 will be in the condition that reset does not start. Then, since the 15th step of output Q15 (1Hz) of a frequency divider 54 is inputted into the clock input terminal of a counter 121, the brake signal LBS2 (brake signal for a movement halt) of H level is outputted in a cycle of 4 seconds from an output terminal Q3 after the 3 - 4 seconds. Consequently, only the period (4 seconds) corresponding to the brake signal LBS2 of the first H level in the brake signal LBS3 serves as H level. Since this brake signal LBS3 is outputted through the OR gate 87, brake control for a movement halt is performed by the brake circuit 20 to a generator 2. That is, brake control for a movement halt is performed only for for 4 seconds. In case a user checks time of day, the abnormalities in movement can be made to recognize easily and certainly by this.

[0086] The flow chart of drawing 9 explains the above actuation.

[0087] In the flow chart of drawing 9 , it differs from the flow chart of drawing 6 in decision of the point that the step ST 13 of the Rota rotation period detection is added, and ST1, in that it judges whether the rotation period is larger than 156ms.

[0088] In this case, in the condition that a rotation period is larger than 156ms, it progresses to ST4 and brake control for a movement halt is performed.

[0089] According to such an operation gestalt, there are the following effects.

[0090] (9) If the counter 121 of the brake signal generation means 120 for a movement halt will be in the condition that reset does not start if it is detected by the rotation period detection means 110 that the rotation period of a generator 2 is larger than 156ms, and the condition continues for 3 to 4 seconds, the brake signal LBS2 from the

output terminal Q3 of a counter 121 will change to H level from L level. Then, since only the period (4 seconds) corresponding to the brake signal LBS2 of the first H level serves as H level that is, since brake control for a movement halt is performed, as for the brake signal LBS3, for 4 seconds can recognize the abnormalities in movement easily and certainly, in case a user checks time of day.

[0091] (The 3rd operation gestalt) The important section of the 3rd operation gestalt of this invention is shown in drawing 10 . In addition, in this description of drawing, about a component the same as that of the 2nd operation gestalt, or equivalent, the same sign is attached, and the explanation is omitted or simplified.

[0092] As for the 3rd operation gestalt, the brake signal generation means for a movement halt differ to the 2nd operation gestalt. The output SP 1 from said rotation period detection means 110 and the brake signal LBS1 from said AND gate 86 are considered as an input, and the AND gate 124 which connected the output to the clear input terminal of said counter 121 is added to the brake signal generation means 120 for a movement halt in this operation gestalt.

[0093] With this operation gestalt, like the flow chart shown in drawing 11 , only when the rotation period of a generator 2 is 156 or less ms and the counter value of an updown counter 60 is more than "12" only when ST1 is NO and ST13 is YES that is, brake control for governing is performed, and when other, brake control for a movement halt is performed by processing of ST5-ST12.

[0094] According to such an operation gestalt, there are the following effects.

[0095] (10) When the rotation period of the generator 2 detected with the rotation period detection means 110 is 156 or less ms and the counter value of an updown counter 60 is in the condition more than "12" When the counter 121 of the brake signal generation means 120 for a movement halt requires reset and it is the other conditions, That is, when the rotation period of the ** generator 2 is larger than 156ms and the counter value of the ** updown counter 60 is below "11" (when it is in the condition that the brake signal for governing is not outputted), ** When it changes into the condition of **** at coincidence, brake control for ** and a movement halt is performed in 4 seconds at the 3 - 4 seconds after being in the condition that the counter 121 of the brake signal generation means 120 for a movement halt does not require reset. In this case, since the condition of ** and ** is supervised and it is made to perform brake control for a movement halt, the abnormalities in movement are certainly [easily and] detectable.

[0096] In addition, this invention is not limited to said operation gestalt, and the deformation in the range which can attain the purpose of this invention, amelioration, etc. are included in this invention.

[0097] With said operation gestalt, although the 4-bit updown counter 60 was used, the updown counter below a triplet may be used and an updown counter 5 bits or more may be used.

[0098] Moreover, what is necessary is just to set up suitably the concrete configuration of a brake circuit 20 and synchronous circuit 70 grade not only in the thing of each of said operation gestalt but in operation.

[0099] Furthermore, with said operation gestalt, although the brake was turned on and turned off at intervals of 4 seconds at the time of the brake control for a movement halt, the setup time which applies this brake may be set as about 2 · 6 seconds that what is necessary is just to set up suitably in consideration of the mechanical load of a clock, the torque of a spiral spring, etc.

[0100] Moreover, this invention is applicable to various clocks, such as what [not only] is applied to an electronics control type machine clock like said operation gestalt but a clock, a clock, etc., a pocket mold clock, the sphygmomanometer of a pocket mold, a cellular phone, a pager, pedmeter, a calculator, a pocket mold personal computer, an electronic notebook, a portable radio, a music box, a metronome, an electric shaver, etc.

[0101]

[Effect of the Invention] As stated above, according to the electronics control type machine clock and its control method of this invention, a user can be told about time-of-day delay, and it can prevent that a user uses a clock while he has been time-of-day delay.

TECHNICAL FIELD

[The technical field to which invention belongs] This invention relates to an electronics control type machine clock and its control method. It is related with the electronics-control type machine clock equipped with the source of mechanical energy, the indicator driven by said source of mechanical energy, the generator which drives by said source of mechanical energy, generates induction power, and supplies electric energy, a brake means apply brakes to said generator, and the roll control equipment which drives by said electric energy and controls the rotation period of said generator through said brake means in detail, and its control method.

PRIOR ART

[Background of the Invention] The electronics control type machine clock which drives correctly the indicator fixed to **** and displays time of day correctly is known by controlling the current value which mechanical energy in case a spiral spring opens is changed into electric energy with a generator, and roll control equipment is operated by the electric energy, and flows in the coil of a generator.

[0003] By such electronics control type machine clock, the torque (mechanical energy) added to a generator by the spiral spring is set up so that an indicator may be rotated more quickly than reference speed, and it is governing the rotation speed by applying brakes with roll control equipment.

EFFECT OF THE INVENTION

[Effect of the Invention] As stated above, according to the electronics control type machine clock and its control method of this invention, a user can be told about time-of-day delay, and it can prevent that a user uses a clock while he has been time-of-day delay.

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] However, when a spiral spring comes loose, the spring force of a spiral spring declines and the running torque of a generator is no longer obtained fully, the rotation speed of a generator falls, and movement also becomes a low speed and will continue being in time of day over long duration.

[0005] Under the present circumstances, in spite of having not carried out a right time stamp only by seeing for a moment in order that a user might check time of day since movement was continued, although it is a low speed, the user had the problem of taking for carrying out normal actuation.

[0006] The purpose of this invention can tell a user about time-of-day delay, and is to offer the electronics control type machine clock which can prevent that a user uses a clock while he has been time-of-day delay, and its control method.

MEANS

[Means for Solving the Problem] An indicator which drives an electronics control type machine clock of this invention by source of mechanical energy, and said source of mechanical energy, A generator which drives by said source of mechanical energy,

generates induction power, and supplies electric energy, In an electronics control type machine clock equipped with a brake means to apply brakes to said generator, and roll control equipment which drives by said electric energy and controls a rotation period of said generator through said brake means A rotation period detection means by which said roll control equipment detects a rotation period of said generator, It is characterized by including a brake signal generation means for a movement halt to output a brake signal for a movement halt which applies brakes for a movement halt to said generator to said brake means a condition [a rotation period of a generator detected with said rotation period detection means having become beyond the set point].

[0008] According to this configuration, if a rotation period of a generator becomes beyond the set point, a brake signal for a movement halt which applies brakes for a movement halt will be outputted to a generator from a brake signal generation means for a movement halt. Then, brake control for a movement halt in a generator is performed by brake means.

[0009] Applying brakes to a generator is continued or, specifically, the hand is moved by brake control for this movement halt by a halt or applying brakes intermittently, in order to make it a low speed very much. Thereby, a halt or since it becomes a low speed very much, when movement checks an indicator by looking for a time-of-day check of a user, it can recognize abnormalities of movement and can tell a user about time-of-day delay. Therefore, with time-of-day delay, a user can prevent using a clock, can demand actuation which winds up a spiral spring from a user, and can return an electronics control type machine clock to normal actuation.

[0010] Moreover, an indicator which drives an electronics control type machine clock of this invention by source of mechanical energy, and said source of mechanical energy, A generator which drives by said source of mechanical energy, generates induction power, and supplies electric energy, In an electronics control type machine clock equipped with a brake means to apply brakes to said generator, and roll control equipment which drives by said electric energy and controls a rotation period of said generator through said brake means A rotation period detection means by which said roll control equipment detects a rotation period of said generator, A comparison means to compare a rotation period and a criteria period of said generator, and a brake signal generation means for governing to output a brake signal for governing to said brake means when it is detected that said rotation period became with this comparison means earlier than a criteria period, It is characterized by including a brake signal generation means for a movement halt to output a brake signal for a movement halt which applies brakes for a movement halt to said generator to said brake means a condition [the condition that

said brake signal for governing was not outputted having continued beyond the setup time].

[0011] According to this configuration, when a rotation period of a generator becomes earlier than a criteria period, a brake signal for governing is outputted to a brake means, and brake control for governing is performed. Therefore, if a rotation period of a generator becomes [mechanical energy from sources of mechanical energy, such as a spiral spring,] large earlier than a criteria period, brake control for governing will be performed and a rotation period will be returned to a criteria period.

[0012] If it is small and mechanical energy from sources of mechanical energy, such as a condition which does not have a rotation period of a generator earlier than a criteria period, i.e., a spiral spring etc., becomes [a rotation period of a generator] later than a criteria period, since brake control for governing will not be performed on the other hand, a rotation period is returned to a criteria period.

[0013] If a condition, i.e., the condition that a brake signal for governing is not outputted, that brake control for this governing is not performed continues beyond the setup time, a brake signal for a movement halt will be outputted to a brake means, and brake control for a movement halt will be performed. Thereby, a halt or since it becomes a low speed very much, when movement checks an indicator by looking for a time-of-day check of a user, it can recognize abnormalities of movement and can tell a user about time-of-day delay. Therefore, with time-of-day delay, a user can prevent using a clock, can demand actuation which winds up a spiral spring from a user, and can return an electronics control type machine clock to normal actuation.

[0014] In this case, as for said brake signal generation means for a movement halt, it is desirable to output a brake signal for a movement halt which applies brakes for a movement halt to said generator to said brake means a condition [the condition that said brake signal for governing was not outputted having continued more than for at least 2 seconds].

[0015] If it does in this way, since a brake signal for a movement halt will be outputted a condition [a condition, i.e., the condition that brake control for governing is not performed, that a brake signal for governing was not outputted having continued more than for at least 2 seconds], it can detect certainly that mechanical energy from sources of mechanical energy, such as a spiral spring, became small, and brake control for a movement halt can be performed. In addition, in the condition that a brake signal for governing is not outputted, time amount until it performs brake control for a movement halt has [that what is necessary is just more than for at least 2 seconds] 3 - 4 desirable seconds.

[0016] Furthermore, an indicator which drives an electronics control type machine clock of this invention by source of mechanical energy, and said source of mechanical energy, A generator which drives by said source of mechanical energy, generates induction power, and supplies electric energy, In an electronics control type machine clock equipped with a brake means to apply brakes to said generator, and roll control equipment which drives by said electric energy and controls a rotation period of said generator through said brake means A rotation period detection means by which said roll control equipment detects a rotation period of said generator, A comparison means to compare a rotation period and a criteria period of said generator, and a brake signal generation means for governing to output a brake signal for governing to said brake means when it is detected that said rotation period became with this comparison means earlier than a criteria period, It is contingent [on at least one condition having continued beyond the setup time, while in the condition that a condition beyond a reference value and said brake signal for governing are not outputted for a rotation period of a generator detected with said rotation period detection means]. It is characterized by including a brake signal generation means for a movement halt to output a brake signal for a movement halt which applies brakes for a movement halt to said generator to said brake means.

[0017] According to this configuration, a rotation period of a generator A condition beyond a reference value, or to a condition that a brake signal for governing is not outputted, and a pan Since a brake signal for a movement halt was made to be outputted a condition [these two conditions having continued beyond the setup time], it detects more certainly that mechanical energy from sources of mechanical energy, such as a spiral spring, became small. Brake control for a movement halt can be performed correctly.

[0018] As for said brake signal generation means for a movement halt, in the above configuration, it is desirable to continue at least 2 seconds or more, and to output said brake signal for a movement halt.

[0019] Since it will continue at least 2 seconds or more to a generator and brake control for a movement halt will be performed when mechanical energy from sources of mechanical energy, such as a spiral spring, becomes small if it does in this way, an indicator changes into an abbreviation halt or a condition near it. Thereby, when a user checks by looking, it can identify whether it has stopped whether an indicator is moving the hand. In addition, time amount which performs brake control for a movement halt has [that what is necessary is just 2 seconds or more] about 3 - 6 desirable seconds.

[0020] Moreover, as for said brake signal generation means for a movement halt, it is

desirable to output said brake signal for a movement halt at intervals of a fixed period.
[0021] If a rotation period of a generator becomes late further as a result of performing brake control since brake control for a movement halt is performed when energy of a source of mechanical energy falls and a rotation period of a generator becomes later than a criteria period, even if it cancels brake control, movement speed will not rise.
[0022] Therefore, while being able to identify whether it has stopped whether an indicator is moving the hand when a user checks by looking if it is made to perform brake control for a movement halt at intervals of a fixed period Since there is a period of which a brake is canceled even when a user notices an indicator a halt and performs time-of-day doubling actuation of an indicator and winding-up actuation of a spiral spring, the time-of-day doubling actuation and winding-up actuation can be performed smoothly, and operability can be made good. And since it is not necessary to be a special brake discharge actuation means, cost reduction can be measured.
[0023] An indicator which drives a control method of an electronics control type machine clock of this invention by source of mechanical energy, and said source of mechanical energy, A generator which drives by said source of mechanical energy, generates induction power, and supplies electric energy, In a control method of an electronics control type machine clock equipped with a brake means to apply brakes to said generator, and roll control equipment which drives by said electric energy and controls a rotation period of said generator through said brake means It is characterized by outputting a brake signal for a movement halt which applies brakes for a movement halt to said generator to said brake means a condition [having detected a rotation period of said generator and a rotation period of a detected generator having become beyond the set point].
[0024] Moreover, a control method of an electronics control type machine clock of this invention A source of mechanical energy, and an indicator driven by said source of mechanical energy, A generator which drives by said source of mechanical energy, generates induction power, and supplies electric energy, In a control method of an electronics control type machine clock equipped with a brake means to apply brakes to said generator, and roll control equipment which drives by said electric energy and controls a rotation period of said generator through said brake means When a rotation period of said generator is detected, a rotation period and a criteria period of a generator which were detected are compared and a rotation period becomes earlier than a criteria period, while outputting a brake signal for governing to said brake means It is characterized by outputting a brake signal for a movement halt which applies brakes for a movement halt to said generator to said brake means a condition [the condition that

said brake signal for governing was not outputted having continued beyond the setup time].

[0025] In this case, it is desirable to output a brake signal for a movement halt which applies brakes to said generator to said brake means a condition [the condition that said brake signal for governing was not outputted having continued more than for at least 2 seconds].

[0026] Furthermore, a control method of an electronics control type machine clock of this invention A source of mechanical energy, and an indicator driven by said source of mechanical energy, A generator which drives by said source of mechanical energy, generates induction power, and supplies electric energy, In an electronics control type machine clock equipped with a brake means to apply brakes to said generator, and roll control equipment which drives by said electric energy and controls a rotation period of said generator through said brake means When a rotation period of said generator is detected, a rotation period and a criteria period of a generator which were detected are compared and a rotation period becomes earlier than a criteria period, while outputting a brake signal for governing to said brake means It is contingent [on at least one condition having continued beyond the setup time, while in the condition that a condition beyond a reference value and said brake signal for governing are not outputted for a rotation period of a detected generator]. It is characterized by outputting a brake signal for a movement halt which applies brakes for a movement halt to said generator to said brake means.

[0027] When an indicator is checked by looking for the same effect as an effect stated by electronics control type machine clock mentioned above, i.e., a time-of-day check of a user, according to these configurations, abnormalities of movement can be recognized and a user can be told about time-of-day delay. Therefore, with time-of-day delay, a user can prevent using a clock, can demand actuation which winds up a spiral spring from a user, and can return an electronics control type machine clock to normal actuation.

[0028]

[Embodiment of the Invention] Below, the operation gestalt of this invention is explained based on a drawing.

[0029] (The 1st operation gestalt) The block diagram showing the electronics control type machine clock of the 1st operation gestalt of this invention is shown in drawing 1 .

[0030] The electronics control type machine clock is equipped with the indicator 4 for time stamps which connects with accelerating **** 3 and accelerating **** 3 as energy transfer equipment which transmits the torque of the spiral spring 1 as a source of mechanical energy, and a spiral spring 1 to a generator 2, and is driven with the torque

of a spiral spring 1.

[0031] A generator 2 is driven by the spiral spring 1 through accelerating **** 3, generates induction power, and supplies electric energy. Through the rectifier circuit 5 which consists of pressure-up rectification, full wave rectification, half-wave rectification, transistor rectification, etc., it is rectified and charge supply of the ac output from this generator 2 is carried out in a pressure up and the power circuit 6 which consisted of capacitors etc.

[0032] In addition, with this operation gestalt, as shown also in drawing 2 , the brake circuit 20 as a brake means including a rectifier circuit 5 is provided in the generator 2. The 1st switch 21 connected to the 1st alternating current input terminal MG 1 into which the AC signal (alternating current) by which this brake circuit 20 was generated with the generator 2 is inputted, By having the 2nd switch 22 connected to the 2nd alternating current input terminal MG 2 into which said AC signal is inputted, and turning on these switches 21 and 22 in coincidence The 1st and 2nd alternating current input terminal MG1 and MG2 is short-circuited, it changes into a closed-loop condition, and short brakes are applied.

[0033] The 1st field effect transistor (FET) 26 of Pch by which the gate was connected to the 2nd alternating current input terminal MG 2, and the 2nd field effect transistor 27 as which the chopper signal (chopper pulse) CH5 from the chopper signal generator 80 mentioned later is inputted into the gate are connected to juxtaposition, and the 1st switch 21 is constituted.

[0034] The 3rd field effect transistor (FET) 28 of Pch by which the gate was connected to the 1st alternating current input terminal MG 1, and the 4th field effect transistor 29 as which the chopper signal CH5 from the chopper signal generator 80 is inputted into the gate are connected to juxtaposition, and the 2nd switch 22 is constituted.

[0035] It has the capacitor 23 for pressure ups connected to the generator 2, diodes 24 and 25, and switches 21 and 22, and the voltage doubler rectifier circuit 5 is constituted. In addition, as diodes 24 and 25, while passing current to an one direction, the class is not asked that what is necessary is just a tropism element. It is desirable to use a Schottky barrier diode and silicon diode with small descent voltage Vf and reverse leakage current as diodes 24 and 25 by the electronics control type machine clock, especially, since the electromotive voltage of a generator 2 is small. And the direct current signal rectified in this rectifier circuit 5 is charged in a power circuit (capacitor) 6.

[0036] Said brake circuit 20 is controlled by the roll control equipment 50 driven with the power supplied from a power circuit 6.

[0037] It has an oscillator circuit 51, the rotation detector 52 as a rotation period detection means, and a control circuit 53, and roll control equipment 50 is constituted, as shown also in drawing 1 .

[0038] An oscillator circuit 51 outputs an oscillation signal (32768Hz) using quartz-resonator 51A which is a source of a time amount standard, and dividing of this oscillation signal is carried out to a certain fixed period by the frequency divider 54 which consists of 15 steps of flip-flops. The 12th step of output Q12 of a frequency divider 54 is outputted as a 8Hz reference signal fs.

[0039] The rotation detector 52 consists of the waveform shaping circuits 61 and the mono-multivibrators 62 which were connected to the generator 2. A waveform shaping circuit 61 consists of amplifier and a comparator, and changes a sine wave into a square wave. The mono-multivibrator 62 functions as a band pass filter which passes only the pulse below a certain period, and outputs the rotation detecting signal FG1 which removed the noise.

[0040] The control circuit 53 is equipped with the updown counter 60, the brake signal generation means 90 for governing, the brake signal generation means 100 for a movement halt, and the chopper signal generator 80 as a comparison means by which the rotation detecting signal FG1 of the rotation detector 52 and the reference signal fs from a frequency divider 54 are inputted through a synchronous circuit 70 and this synchronous circuit 70.

[0041] The synchronous circuit 70 is adjusted so that each of these signal pulses may lap and may not be outputted, while consisting of four flip-flops 71, the AND gate 72, and NAND gate 73 and synchronizing the rotation detecting signal FG1 with a reference signal fs (8Hz) using the signal of the 5th step of output Q5 (1024Hz) of a frequency divider 54, or the 6th step of output Q6 (512Hz).

[0042] The updown counter 60 consists of 4-bit counters. The signal based on said rotation detecting signal FG1 in the rise count input of an updown counter 60 is inputted from a synchronous circuit 70, and the signal based on said reference signal fs in a down count input is inputted from a synchronous circuit 70. Thereby, counting and calculation of a difference of a reference signal fs and the rotation detecting signal FG1 can carry out now to coincidence.

[0043] In addition, four data input terminal (presetting terminal) A-D is prepared in this updown counter 60, and the initial preset value (initial counter value) of an updown counter 60 is set as "11" in H level signal being inputted into Terminals A, B, and D.

[0044] Moreover, the system-reset signal SR from the initialization circuit 92 connected to the power circuit 6 is inputted into the LOAD input terminal of an updown counter 60.

In addition, if the signal of H level is outputted and it becomes more than predetermined voltage until the charge voltage of a power circuit 6 turns into predetermined voltage, the initialization circuit 92 consists of these operation gestalten so that the signal of L level may be outputted.

[0045] In order that an updown counter 60 may not receive an up-and-down input until the system-reset signal SR is canceled until a LOAD input is set to L level that is, the counter value of an updown counter 60 is maintained by "11."

[0046] The updown counter 60 has 4-bit output QA-QD. Therefore, with [a counter value] "12", both 3 and the outputs QC and QD of the 4th bit output H level signal, but with [a counter value] "11", neither 3 nor the outputs QC and QD of the 4th bit output H level signal. [more than] [below] These outputs QC and QD are inputted into the brake signal generation means 90 for governing.

[0047] In addition, each output of NAND gate 74 where output QA-QD was inputted, and the OR gate 75 is inputted into said NAND gate 73, respectively. If it follows, for example, two or more inputs of a rise count signal continue and a counter value is set to "15", even if L level signal will be outputted from NAND gate 74 and a rise count signal will be further inputted into NAND gate 73, the input is set up so that it may be canceled and a rise count signal may not be inputted into an updown counter 60 any more. If a counter value is set to "0", since similarly L level signal will be outputted from the OR gate 75, the input of a down count signal is canceled. Thereby, it is set up so that it may not be set to "0" or a counter value may not be set to "15" more than "0" more than "15."

[0048] The brake signal generation means 90 for governing is constituted by the AND gate 86 which outputs the brake signal LBS1 using the outputs QC and QD of an updown counter 60. That is, a counter value is outputted above "12" and the brake signal LBS1 of L level is outputted [the counted value of an updown counter 60] for the brake signal LBS1 (brake signal for governing) of H level from the AND gate 86 below by "11" from the AND gate 86, respectively.

[0049] The brake signal generation means 100 for a movement halt is constituted by the counter 101 which connected the output of said AND gate 86 to the clear input terminal. The 15th step of output Q15 (1Hz) of said frequency divider 54 is connected to the clock input terminal of a counter 101. Therefore, if the counted value of an updown counter 60 becomes below "11", reset will stop a counter 101 requiring, the brake signal LBS2 (brake signal for a movement halt) of H level will be outputted from an output terminal Q3 after 3 - 4 seconds, and H level and L level will specifically be repeated in a cycle of 4 seconds 1 fixed cycle. In addition, the brake signals LBS1 and LBS2 are both inputted

into the chopper signal generator 80 through the OR gate 87.

[0050] The AND gate 82 where the chopper signal generator 80 outputs the 1st chopper signal CH1 using the outputs Q5-Q8 of a frequency divider 54, The OR gate 83 which outputs the 2nd chopper signal CH2 using the outputs Q5-Q8 of a frequency divider 54, It has the NOR gate 85 where the AND gate 84 where the output CH3 of said OR gate 87 and the 2nd chopper signal CH2 are inputted, and the output CH4 of this AND gate 84 and the 1st chopper signal CH1 are inputted.

[0051] The output CH5 from the NOR gate 85 is inputted into the gate of the Pch transistors 27 and 29. While the output CH5 serves as L level, it is maintained by the ON state, a generator 2 short-circuits, and transistors 27 and 29 require a brake. On the other hand, while the output CH5 serves as H level, transistors 27 and 29 are maintained by the OFF state and a brake does not start a generator 2. Therefore, chopper ring control of the generator 2 can be carried out with the output CH5 from the NOR gate 85.

[0052] Here, the duty ratio of each of said chopper signals CH1 and CH2 is the ratio of the time amount which has applied brakes to the generator 2 among one period of the chopper signal, and is the ratio of the time amount which serves as H level among one period in each chopper signals CH1 and CH2 with this operation gestalt. For example, the duty ratio of each chopper signals CH1 and CH2 is set up as shown in drawing 3 .

[0053] Now, when the output CH3 from the NOR gate 87 is L level signal, an output CH4 also serves as L level (when both the brake signals LBS1 and LBS2 are L level). For this reason, the chopper signal which the chopper signal CH1 reversed of the output CH5 from the NOR gate 85, i.e., H level period, (brake-off period) is as long as 15/16, and L level period (brake "on" period) serves as 1/16 and a chopper signal with the small (1/16) duty ratio (ratio which turns on switches 21 and 22) which is short, that is, performs weak brake control. Therefore, to a generator 2, weak brake control which gave priority to the generation-of-electrical-energy force is performed.

[0054] On the other hand, when the output CH3 from the NOR gate 87 is H level signal, from the AND gate 84, the chopper signal CH2 is outputted as it is (when either of the brake signals LBS1 and LBS2 is H level), and an output CH4 becomes the same as that of the chopper signal CH2. For this reason, the chopper signal which reversed the output CH2 of the output CH5 from the NOR gate 85, i.e., H level period, (brake-off period) is as short as 1/16, and L level period (brake "on" period) serves as 15/16 and a chopper signal with the big (15/16) duty ratio which is long, that is, performs strong brake control. Therefore, an output CH5 can improve damping torque, chopper ring control being performed and suppressing the fall of generated output, since it becomes

H level signal a fixed period and a short brake is turned off, although the total time amount of L level signal which applies short brakes to a generator 2 becomes long and strong brake control is performed to a generator 2.

[0055] Therefore, strong brake control according [the output CH3 from the NOR gate 87] to a chopper signal with a big duty ratio is performed between H level signals, and weak brake control by the chopper signal with a small duty ratio is performed between L level signals. That is, strong brake control and weak brake control are changed by the output CH3 from the NOR gate 87.

[0056] In addition, in this invention, a strong brake and a weak brake are relative, and a strong brake means that a brake force is strong compared with a weak brake. What is necessary is just to set up suitably the duty ratio and frequency of the concrete brake force in each brake, i.e., a ** chopper brake signal, in operation.

[0057] Next, the actuation in this operation gestalt is explained with reference to the timing chart of drawing 4 and drawing 5 .

[0058] If a generator 2 begins to operate and the system-reset signal SR of L level is inputted into the LOAD input of an updown counter 60 from the initialization circuit 92, as shown in drawing 4 , the rise count signal based on the rotation detecting signal FG1 and the down count signal based on a reference signal fs will count by the updown counter 60. Each of these signals are set up so that it may not be inputted into a counter 60 by the synchronous circuit 70 at coincidence.

[0059] For this reason, if a rise count signal is inputted, a counter value will be set to "12" and the brake signal LBS1 from the AND gate 86 will turn into H level signal from the condition that initial counted value is set as "11." Since the brake signal LBS2 from the outgoing end Q3 of the brake signal generation means 100 (counter 101) for a movement halt is still L level at this time, the brake signal LBS1 is outputted as it is, and, as for the output CH3 from the OR gate 87, brake control for governing is performed by the brake circuit 20 to a generator 2. And with [a counter value] "12", the brake control for governing is continued. [more than]

[0060] On the contrary, if a down count signal is inputted and a counter value becomes below "11", the brake signal LBS1 will serve as L level. Since the brake signal LBS2 from the outgoing end Q3 of a counter 101 is still L level, the output CH3 from the OR gate 87 is L level until this condition passes for 3 to 4 seconds at this time. For this reason, the output CH5 from the NOR gate 85 The chopper signal which the chopper signal CH1 reversed, i.e., H level period, (brake-off period) is as long as 15/16. Since L level period (brake "on" period) serves as 1/16 and a chopper signal with the small (1/16) duty ratio (ratio which turns on switches 21 and 22) which is short, that is, performs

weak brake control, to a generator 2, weak brake control which gave priority to the generation-of-electrical-energy force is performed.

[0061] Thus, if it controls, as shown in drawing 4 , a rise counter signal and a down counter signal will be inputted by turns, and a counter value will shift to the lock condition which repeats "12" and "11." As a result of repeating strong brake control and weak brake control according to a counter value in this case, a generator 2 is maintained near the set-up rotation speed.

[0062] On the other hand, since a counter value is [the brake signal LBS1] L level in the condition below "11", a counter 101 is in the condition that reset does not start. Since the 15th step of output Q15 (1Hz) of a frequency divider 54 is inputted into the clock input terminal of a counter 101, as shown in drawing 5 , the brake signal LBS2 (brake signal for a movement halt) of H level is outputted from an output terminal Q3 after the 3 - 4 seconds, and it is stopped after 4 seconds. Then, the brake signal LBS2 (brake signal for a movement halt) is outputted after 4 seconds, and this is repeated. Since the brake signal LBS1 is still L level at this time, the brake signal LBS2 is outputted as it is, and, as for the output CH3 from the OR gate 87, brake control for a movement halt is performed by the brake circuit 20 to a generator 2. That is, since movement changes into the condition near a halt or it as a result of performing brake control for a movement halt for 4 seconds and repeating it in a cycle of 4 seconds, in case a user checks time of day, the abnormalities in movement can be recognized easily and certainly.

[0063] The flow chart of drawing 6 explains the above actuation.

[0064] In step (it omits Following ST) 1, it judges whether it is brake control for governing. While performing brake control for governing with [the counter value of the uptown counter 60] "12", [more than] Both the timer 1 (timer which measures the brake signal OFF time amount for a movement halt), and the timer 2 (timer which measures the brake signal ON time amount for a movement halt) are reset by ST2. Then, after setting to F= 0 a flag (flag which memorizes ON of the brake signal for a movement halt, and an OFF condition) by ST3, the processing which returns to ST1 is repeated.

[0065] In decision of ST1, with [the counter value of the uptown counter 60] "11", it progresses to ST4 and judges whether it is flag F-1. [below] If it is not flag F-1 (condition of OFF of the brake signal for a movement halt) and is, it will judge whether it progressed to ST5 and the timer 1 passed for 3 seconds. A counter value is below "11", and if the condition that it is not flag F-1 passes for 3 seconds, the brake signal for a movement halt is started by ST6, and it considers as F-1 by ST7, and after starting a

timer 2 by ST8, it will return to ST1.

[0066] Then, since it is recognized in ST4 that it is F-1, it judges whether it progressed to ST9 and the timer 2 passed for 4 seconds. If a counter value is below "11" and the condition of flag F-1 passes for 4 seconds, F= 0 and a timer 2 will be reset by ST10, a timer 1 will be reset by ST11, and the brake signal for a movement halt will be stopped by ST12. then, the result by which processing of STs 1, 4-8 and processing of STs 1, 4, 9-12 are repeated -- the brake control for a movement halt -- being periodic (4-second gap) -- it is repeated.

[0067] According to such this operation gestalt, there are the following effects.

[0068] (1) Since the brake signal generation means 100 for a movement halt other than the brake signal generation means 90 (AND gate 86) for governing for performing brake control for the usual governing as roll control equipment 50 was established The torque of a spiral spring 1 falls, the rotation period of a generator 2 becomes late compared with a criteria period, and when movement also becomes slow and deviation produces it in the time stamp of an indicator 4, brake control for a movement halt can be performed to a generator 2. For this reason, when the clock is not moving the hand normally, movement can be recognized, it can be made a low speed very much, and a halt or in case the user of a clock checks time of day, the abnormalities in movement can be recognized easily and certainly, and use of the electronics control type machine clock in the condition of having governed correctly can be urged.

[0069] (2) When the rotation period of a generator 2 becomes earlier than a criteria period, the brake signal for governing (brake signal LBS1 of H level) is outputted to a brake circuit 20, and it is performed, the brake control, i.e., the strong brake control, for governing. Therefore, if the rotation period of a generator 2 becomes [the mechanical energy from a spiral spring 1] large earlier than a criteria period, brake control for governing will be performed and a rotation period will be returned to a criteria period.

[0070] If it is small and the rotation period of a generator 2 becomes later than a criteria period as for the condition which does not have the rotation period of a generator 2 earlier than a criteria period, i.e., the mechanical energy from a spiral spring 1, weak brake control will be performed. That is, since brake control for governing is not performed, a rotation period is returned to a criteria period.

[0071] Thus, it is maintainable by repeating strong brake control and weak brake control near the rotation speed which had the generator 2 set up.

[0072] (3) the condition that brake control for governing is not performed -- the setup time -- if it continues 3 to 4 seconds or more, the brake signal for a movement halt (brake signal LBS2 of H level) will be outputted to a brake circuit 20, and, specifically,

brake control for a movement halt will be performed.

[0073] Therefore, since brake control for a movement halt is performed a condition [the condition that brake control for governing was not performed having continued 3 to 4 seconds or more], it can detect certainly that the mechanical energy from a spiral spring 1 became small, and brake control for a movement halt can be performed.

[0074] (4) In the brake control for a movement halt, since strong brake control during at least 4 seconds is performed, movement changes into the condition certainly near a halt or it. Therefore, when an indicator is checked by looking for a time-of-day check of a user, the abnormalities of movement can be recognized and a user can be told about time-of-day delay. Therefore, with time-of-day delay, a user can prevent using a clock, can demand the actuation which winds up a spiral spring 1 from a user, and can return an electronics control type machine clock to normal actuation.

[0075] (5) If the rotation period of a generator becomes late further as a result of performing brake control since brake control for a movement halt is performed when the energy of a spiral spring 1 falls and the rotation period of a generator 2 becomes later than a criteria period, even if it cancels brake control, movement speed will not rise.

[0076] While being able to identify whether it has stopped whether the indicator is moving the hand with this operation gestalt when a user checks by looking since brake control for a movement halt is performed at intervals of the periods of 4 seconds Since there is a period of which the brake is canceled even when a user notices an indicator 4 a halt and performs time-of-day doubling actuation of an indicator 4 and winding-up actuation of a spiral spring 1, the time-of-day doubling actuation and winding-up actuation can be performed smoothly, and operability can be made good. And since it is not necessary to be a special brake discharge actuation means, cost reduction can be measured.

[0077] (6) A counter value is more than "12", or the brake control for governing is below "11", or since it is set up with a chisel, it does not need to set up a braking time etc. separately, roll control equipment 50 can be made as for it to a simple configuration, and it can reduce components cost and a manufacturing cost, and can offer an electronics control type machine clock cheaply.

[0078] (7) Since the timing into which a rise counter signal is inputted changes according to the rotational speed of a generator 2, the time amount of strong brake control can also be adjusted automatically. For this reason, quick stable control of responsibility can be performed in the state of the lock into which a rise counter signal and a down count signal are inputted especially by turns.

[0079] (8) Since roll control equipment 50 is carrying out brake control of the generator

2 in having the brake circuit 20 which has the transistors 27 and 29 which can short-circuit the both ends of a generator 2, impressing the brake signal which becomes transistors 27 and 29 from a square wave pulse, and turning on and turning off transistors 27 and 29, it can simplify the configuration of a brake circuit 20 and can reduce cost.

[0080] (The 2nd operation gestalt) The important section of the 2nd operation gestalt of this invention is shown in drawing 6 . In addition, in this description of drawing, about a component the same as that of the 1st operation gestalt, or equivalent, the same sign is attached, and the explanation is omitted or simplified.

[0081] With the 2nd operation gestalt, in the 1st operation gestalt, the brake signal generation means 100 for a movement halt is deleted, and the rotation period detection means 110 and the brake signal generation means 120 for a movement halt are established instead of it.

[0082] The rotation period detection means 110 is equipped with six steps of frequency dividers 111 which carry out dividing of the 7th step of output Q7 of said frequency divider 54, the NOR gate 112 which considers the 4th step and the 6th step of outputs F4 and F6 of this frequency divider 111 as an input, the flip-flop 113 which connected the output of this NOR gate 112 to CK input terminal, and the flip-flop 114 which connected Q output terminal of this flip-flop 113 to D input edge. In addition, the output FG2 of the AND gate 72 in said synchronous circuit 70 is inputted into the clear terminal of a frequency divider 111. Moreover, in the flip-flop 113, the signal of H level is inputted into D input edge for the output FG2 of the AND gate 72 in a synchronous circuit 70 in the clear input edge, respectively. Moreover, said rotation detecting signal FG1 is inputted into CK input edge of a flip-flop 114. Therefore, although the rotation period of a generator 2 is [SP1] L level between 156ms or more, the rotation period of a generator 2 serves as [SP1] H level in less than 156ms.

[0083] The brake signal generation means 120 for a movement halt is equipped with the counter 121 which connected the reversal output of said flip-flop 114 to the clear input terminal, the flip-flop 122 which connected the output terminal Q3 of this counter 121 to CK input terminal, and the AND gate 123 which considers the output from the output terminal Q3 of said counter 121, and the reversal output of a flip-flop 122 as an input. In addition, the output (1Hz) from the output Q15 of said frequency divider 54 is inputted into the clock input terminal of a counter 121. Moreover, the output SP 1 of said flip-flop 114 is carried out at CR inversed input terminal of a flip-flop 122, and the ******** input of the signal of H level is carried out in D input edge.

[0084] Therefore, as for a counter 121, in less than 156ms after the rotation period of a

generator 2 is H level, SP1 is reset for it, and the signal of H level is not outputted from an output terminal Q3.

[0085] However, if the rotation period of a generator 2 is set to 156ms or more, as shown in drawing 8 , SP1 is set to L level and a counter 121 will be in the condition that reset does not start. Then, since the 15th step of output Q15 (1Hz) of a frequency divider 54 is inputted into the clock input terminal of a counter 121, the brake signal LBS2 (brake signal for a movement halt) of H level is outputted in a cycle of 4 seconds from an output terminal Q3 after the 3 - 4 seconds. Consequently, only the period (4 seconds) corresponding to the brake signal LBS2 of the first H level in the brake signal LBS3 serves as H level. Since this brake signal LBS3 is outputted through the OR gate 87, brake control for a movement halt is performed by the brake circuit 20 to a generator 2. That is, brake control for a movement halt is performed only for for 4 seconds. In case a user checks time of day, the abnormalities in movement can be made to recognize easily and certainly by this.

[0086] The flow chart of drawing 9 explains the above actuation.

[0087] In the flow chart of drawing 9 , it differs from the flow chart of drawing 6 in decision of the point that the step ST 13 of the Rota rotation period detection is added, and ST1, in that it judges whether the rotation period is larger than 156ms.

[0088] In this case, in the condition that a rotation period is larger than 156ms, it progresses to ST4 and brake control for a movement halt is performed.

[0089] According to such an operation gestalt, there are the following effects.

[0090] (9) If the counter 121 of the brake signal generation means 120 for a movement halt will be in the condition that reset does not start if it is detected by the rotation period detection means 110 that the rotation period of a generator 2 is larger than 156ms, and the condition continues for 3 to 4 seconds, the brake signal LBS2 from the output terminal Q3 of a counter 121 will change to H level from L level. Then, since only the period (4 seconds) corresponding to the brake signal LBS2 of the first H level serves as H level that is, since brake control for a movement halt is performed, as for the brake signal LBS3, for 4 seconds can recognize the abnormalities in movement easily and certainly, in case a user checks time of day.

[0091] (The 3rd operation gestalt) The important section of the 3rd operation gestalt of this invention is shown in drawing 10 . In addition, in this description of drawing, about a component the same as that of the 2nd operation gestalt, or equivalent, the same sign is attached, and the explanation is omitted or simplified.

[0092] As for the 3rd operation gestalt, the brake signal generation means for a movement halt differ to the 2nd operation gestalt. The output SP 1 from said rotation

period detection means 110 and the brake signal LBS1 from said AND gate 86 are considered as an input, and the AND gate 124 which connected the output to the clear input terminal of said counter 121 is added to the brake signal generation means 120 for a movement halt in this operation gestalt.

[0093] With this operation gestalt, like the flow chart shown in drawing 11 , only when the rotation period of a generator 2 is 156 or less ms and the counter value of an updown counter 60 is more than "12" only when ST1 is NO and ST13 is YES that is, brake control for governing is performed, and when other, brake control for a movement halt is performed by processing of ST5-ST12.

[0094] According to such an operation gestalt, there are the following effects.

[0095] (10) When the rotation period of the generator 2 detected with the rotation period detection means 110 is 156 or less ms and the counter value of an updown counter 60 is in the condition more than "12" When the counter 121 of the brake signal generation means 120 for a movement halt requires reset and it is the other conditions, That is, when the rotation period of the ** generator 2 is larger than 156ms and the counter value of the ** updown counter 60 is below "11" (when it is in the condition that the brake signal for governing is not outputted), ** When it changes into the condition of **** at coincidence, brake control for ** and a movement halt is performed in 4 seconds at the 3 - 4 seconds after being in the condition that the counter 121 of the brake signal generation means 120 for a movement halt does not require reset. In this case, since the condition of ** and ** is supervised and it is made to perform brake control for a movement halt, the abnormalities in movement are certainly [easily and] detectable.

[0096] In addition, this invention is not limited to said operation gestalt, and the deformation in the range which can attain the purpose of this invention, amelioration, etc. are included in this invention.

[0097] With said operation gestalt, although the 4-bit updown counter 60 was used, the updown counter below a triplet may be used and an updown counter 5 bits or more may be used.

[0098] Moreover, what is necessary is just to set up suitably the concrete configuration of a brake circuit 20 and synchronous circuit 70 grade not only in the thing of each of said operation gestalt but in operation.

[0099] Furthermore, with said operation gestalt, although the brake was turned on and turned off at intervals of 4 seconds at the time of the brake control for a movement halt, the setup time which applies this brake may be set as about 2 - 6 seconds that what is necessary is just to set up suitably in consideration of the mechanical load of a clock, the torque of a spiral spring, etc.

[0100] Moreover, this invention is applicable to various clocks, such as what [not only] is applied to an electronics control type machine clock like said operation gestalt but a clock, a clock, etc., a pocket mold clock, the sphygmomanometer of a pocket mold, a cellular phone, a pager, pedmeter, a calculator, a pocket mold personal computer, an electronic notebook, a portable radio, a music box, a metronome, an electric shaver, etc.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is the block diagram showing the configuration of the important section of the electronics control type machine clock in the 1st operation gestalt of this invention.

[Drawing 2] It is the circuit diagram showing the configuration of the electronics control type machine clock of the 1st operation gestalt.

[Drawing 3] It is the timing chart which shows actuation of the chopper control section of the 1st operation gestalt.

[Drawing 4] In the 1st operation gestalt, it is the timing chart which usually shows the control timing at the time.

[Drawing 5] In the 1st operation gestalt, it is the timing chart which shows the control timing at the time of low-speed rotation.

[Drawing 6] It is the flow chart which shows actuation of the 1st operation gestalt.

[Drawing 7] It is the circuit diagram showing the important section of the 2nd operation gestalt of this invention.

[Drawing 8] In the 2nd operation gestalt, it is the timing chart which shows the control timing at the time of low-speed rotation.

[Drawing 9] It is the flow chart which shows actuation of the 2nd operation gestalt.

[Drawing 10] It is the circuit diagram showing the important section of the 3rd operation gestalt of this invention.

[Drawing 11] It is the flow chart which shows actuation of the 3rd operation gestalt.

[Description of Notations]

1 Spiral Spring (Source of Mechanical Energy)

2 Generator

4 Indicator

5 Voltage Doubler Rectifier Circuit

6 Power Circuit

20 Brake Circuit (Brake Means)

50 Roll Control Equipment
52 Rotation Detector (Rotation Period Detection Means)
60 Updown Counter (Comparison Means)
70 Synchronous Circuit
80 Chopper Signal Generator
90 Brake Signal Generation Means for Governing
100 Brake Signal Generation Means for Movement Halt
110 Rotation Period Detection Means
120 Brake Signal Generation Means for Movement Halt

[Translation done.]

(19)日本国特許庁（ＪＰ）　(12)公開特許公報（Ａ）　(11)特許出願公開番号
特開2001－51070
（P2001－51070A）
(43)公開日　平成13年２月23日(2001.2.23)

(51)Int.Cl.⁷	識別記号	ＦＩ		テーマコード（参考）
Ｇ０４Ｂ　9/00		Ｇ０４Ｂ　9/00		２Ｆ０８２
17/00		17/00	Ｚ	５Ｈ５９０
Ｇ０４Ｃ　3/00		Ｇ０４Ｃ　3/00	Ｄ	
Ｈ０２Ｐ　9/00		Ｈ０２Ｐ　9/00	Ｚ	

審査請求　未請求　請求項の数10　ＯＬ　（全 15 頁）

(21)出願番号　特願平11－227458

(22)出願日　平成11年８月11日(1999.8.11)

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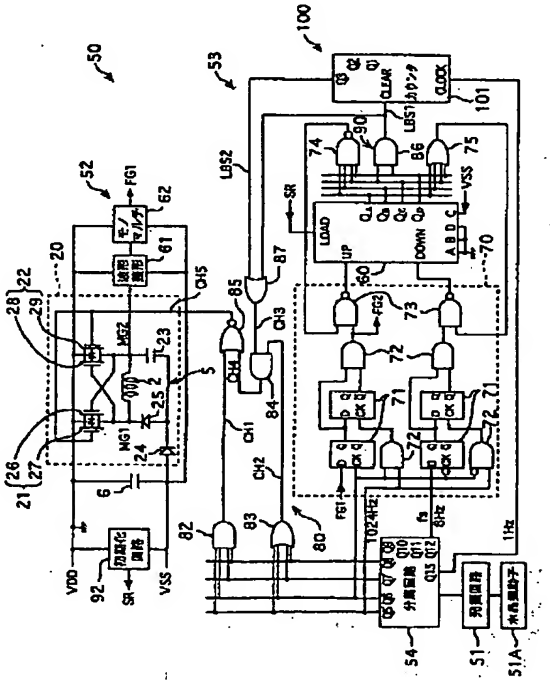
最終頁に続く

(54)【発明の名称】　電子制御式機械時計およびその制御方法

(57)【要約】
【課題】　使用者に時刻遅れを知らせることができ、時刻遅れのまま使用者が時計を使用することを防止できる電子制御式機械時計を提供すること。
【解決手段】　電子制御式機械時計は、ゼンマイ１からの機械エネルギを電気エネルギに変換する発電機２の回転周期を制御する回転制御装置５０を備える。装置５０は、発電機２の回転周期と基準周期とを比較するアップダウンカウンタ６０と、アップダウンカウンタ６０の値が１２以上のとき（回転周期が基準周期よりも早くなったとき）、Ｈレベルのブレーキ信号ＬＢＳ１（調速用ブレーキ信号）を出力する調速用ブレーキ信号発生手段９０と、調速用ブレーキ信号が出力されない状態が４秒以上継続したときＨレベルのブレーキ信号ＬＢＳ２（逆針停止用ブレーキ信号を出力する逆針停止用ブレーキ信号発生手段１００を備える。



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【特許請求の範囲】

【請求項１】　機械的エネルギ源と、前記機械的エネルギ源によって駆動される指針と、前記機械的エネルギ源によって駆動され誘起電力を発生して電気的エネルギを供給する発電機と、前記発電機にブレーキを掛けるブレーキ手段と、前記電気的エネルギにより駆動され前記ブレーキ手段を介して前記発電機の回転周期を制御する回転制御装置とを備える電子制御式機械時計において、

前記回転制御装置は、前記発電機の回転周期を検出する回転周期検出手段と、前記回転周期検出手段で検出された発電機の回転周期が設定値以上になったことを条件として、前記ブレーキ手段に対して前記発電機に運針停止用のブレーキを掛ける運針停止用ブレーキ信号を出力する運針停止用ブレーキ信号発生手段とを含むことを特徴とする電子制御式機械時計。

【請求項２】　機械的エネルギ源と、前記機械的エネルギ源によって駆動される指針と、前記機械的エネルギ源によって駆動され誘起電力を発生して電気的エネルギを供給する発電機と、前記発電機にブレーキを掛けるブレーキ手段と、前記電気的エネルギにより駆動され前記ブレーキ手段を介して前記発電機の回転周期を制御する回転制御装置とを備える電子制御式機械時計において、

前記回転制御装置は、前記発電機の回転周期を検出する回転周期検出手段と、前記発電機の回転周期と基準周期とを比較する比較手段と、この比較手段によって前記回転周期が基準周期よりも早くなったことが検出されたときに前記ブレーキ手段に対して調速用ブレーキ信号を出力する調速用ブレーキ信号発生手段と、前記調速用ブレーキ信号が出力されない状態が設定時間以上継続したことを条件として、前記ブレーキ手段に対して前記発電機に運針停止用のブレーキを掛ける運針停止用ブレーキ信号を出力する運針停止用ブレーキ信号発生手段とを含むことを特徴とする電子制御式機械時計。

【請求項３】　請求項２に記載の電子制御式機械時計において、

前記運針停止用ブレーキ信号発生手段は、前記調速用ブレーキ信号が出力されない状態が少なくとも２秒間以上継続したことを条件として、前記ブレーキ手段に対して前記発電機に運針停止用のブレーキを掛ける運針停止用ブレーキ信号を出力することを特徴とする電子制御式機械時計。

【請求項４】　機械的エネルギ源と、前記機械的エネルギ源によって駆動される指針と、前記機械的エネルギ源によって駆動され誘起電力を発生して電気的エネルギを供給する発電機と、前記発電機にブレーキを掛けるブレーキ手段と、前記電気的エネルギにより駆動され前記ブレーキ手段を介して前記発電機の回転周期を制御する回転制御装置とを備える電子制御式機械時計において、

前記回転制御装置は、前記発電機の回転周期を検出する回転周期検出手段と、前記発電機の回転周期と基準周期

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とを比較する比較手段と、この比較手段によって前記回転周期が基準周期よりも早くなったことが検出されたときに前記ブレーキ手段に対して調速用ブレーキ信号を出力する調速用ブレーキ信号発生手段と、前記回転周期検出手段で検出された発電機の回転周期が基準値以上の状態および前記調速用ブレーキ信号が出力されない状態のうち少なくとも１つの状態が設定時間以上継続したことを条件として、前記ブレーキ手段に対して前記発電機に運針停止用のブレーキを掛ける運針停止用ブレーキ信号を出力する運針停止用ブレーキ信号発生手段を含むことを特徴とする電子制御式機械時計。

【請求項５】　請求項１ないし請求項４のいずれかに記載の電子制御式機械時計において、

前記運針停止用ブレーキ信号発生手段は、前記運針停止用ブレーキ信号を少なくとも２秒以上継続して出力することを特徴とする電子制御式機械時計。

【請求項６】　請求項５に記載の電子制御式機械時計において、

前記運針停止用ブレーキ信号発生手段は、前記運針停止用ブレーキ信号を一定周期間隔で出力することを特徴とする電子制御式機械時計。

【請求項７】　機械的エネルギ源と、前記機械的エネルギ源によって駆動される指針と、前記機械的エネルギ源によって駆動され誘起電力を発生して電気的エネルギを供給する発電機と、前記発電機にブレーキを掛けるブレーキ手段と、前記電気的エネルギにより駆動され前記ブレーキ手段を介して前記発電機の回転周期を制御する回転制御装置とを備える電子制御式機械時計の制御方法において、

前記発電機の回転周期を検出し、検出された発電機の回転周期が設定値以上になったことを条件として、前記ブレーキ手段に対して前記発電機に運針停止用のブレーキを掛ける運針停止用ブレーキ信号を出力することを特徴とする電子制御式機械時計の制御方法。

【請求項８】　機械的エネルギ源と、前記機械的エネルギ源によって駆動される指針と、前記機械的エネルギ源によって駆動され誘起電力を発生して電気的エネルギを供給する発電機と、前記発電機にブレーキを掛けるブレーキ手段と、前記電気的エネルギにより駆動され前記ブレーキ手段を介して前記発電機の回転周期を制御する回転制御装置とを備える電子制御式機械時計の制御方法において、

前記発電機の回転周期を検出し、検出された発電機の回転周期と基準周期とを比較して回転周期が基準周期よりも早くなったときに前記ブレーキ手段に調速用ブレーキ信号を出力するとともに、前記調速用ブレーキ信号が出力されない状態が設定時間以上継続したことを条件として、前記ブレーキ手段に対して前記発電機に運針停止用のブレーキを掛ける運針停止用ブレーキ信号を出力することを特徴とする電子制御式機械時計の制御方法。

【請求項９】　請求項８に記載の電子制御式機械時計の制御方法において、
前記調速用ブレーキ信号が出力されない状態が少なくとも２秒間以上継続したことを条件として、前記ブレーキ手段に対して前記発電機にブレーキを掛ける運針停止用ブレーキ信号を出力することを特徴とする電子制御式機械時計の制御方法。

【請求項１０】　機械的エネルギ源と、前記機械的エネルギ源によって駆動される指針と、前記機械的エネルギ源によって駆動され誘起電力を発生して電気的エネルギを供給する発電機と、前記発電機にブレーキを掛けるブレーキ手段と、前記電気的エネルギにより駆動され前記ブレーキ手段を介して前記発電機の回転周期を制御する回転制御装置とを備える電子制御式機械時計において、前記発電機の回転周期を検出し、検出された発電機の回転周期と基準周期とを比較して回転周期が基準周期よりも早くなったときに前記ブレーキ手段に調速用ブレーキ信号を出力するとともに、検出された発電機の回転周期が基準値以上の状態および前記調速用ブレーキ信号が出力されない状態のうち少なくとも１つの状態が設定時間以上継続したことを条件として、前記ブレーキ手段に対して前記発電機に運針停止用のブレーキを掛ける運針停止用ブレーキ信号を出力することを特徴とする電子制御式機械時計の制御方法。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、電子制御式機械時計およびその制御方法に関する。詳しくは、機械的エネルギ源と、前記機械的エネルギ源によって駆動される指針と、前記機械的エネルギ源によって駆動され誘起電力を発生して電気的エネルギを供給する発電機と、前記発電機にブレーキを掛けるブレーキ手段と、前記電気的エネルギにより駆動され前記ブレーキ手段を介して前記発電機の回転周期を制御する回転制御装置とを備える電子制御式機械時計およびその制御方法に関する。

【０００２】

【背景技術】ゼンマイが開放する時の機械的エネルギを発電機で電気的エネルギに変換し、その電気的エネルギにより回転制御装置を作動させて発電機のコイルに流れる電流値を制御することにより、輪列に固定される指針を正確に駆動して時刻を正確に表示する電子制御式機械時計が知られている。

【０００３】このような電子制御式機械時計では、ゼンマイによって発電機に加えられるトルク（機械的エネルギ）は、指針を基準スピードよりも速く回転させるように設定されており、その回転スピードを回転制御装置によってブレーキを掛けることで調速している。

【０００４】

【発明が解決しようとする課題】しかしながら、ゼンマイがほどけてゼンマイのばね力が低下し、発電機の回転トルクが十分に得られなくなったときには、発電機の回転スピードが低下し、運針も低速になって、時刻が長時間にわたって遅れ続けてしまう。

【０００５】この際、低速ではあるが運針は続けられるため、使用者が時刻を確認するために一瞬見ただけでは、正しい時刻表示されていないにもかかわらず、使用者は正常動作していると誤認してしまうという問題があった。

【０００６】本発明の目的は、使用者に時刻遅れを知らせることができ、時刻遅れのまま使用者が時計を使用することを防止することができる電子制御式機械時計およびその制御方法を提供することにある。

【０００７】

【課題を解決するための手段】本発明の電子制御式機械時計は、機械的エネルギ源と、前記機械的エネルギ源によって駆動される指針と、前記機械的エネルギ源によって駆動され誘起電力を発生して電気的エネルギを供給する発電機と、前記発電機にブレーキを掛けるブレーキ手段と、前記電気的エネルギにより駆動され前記ブレーキ手段を介して前記発電機の回転周期を制御する回転制御装置とを備える電子制御式機械時計において、前記回転制御装置は、前記発電機の回転周期を検出する回転周期検出手段と、前記回転周期検出手段で検出された発電機の回転周期が設定値以上になったことを条件として、前記ブレーキ手段に対して前記発電機に運針停止用のブレーキを掛ける運針停止用ブレーキ信号を出力する運針停止用ブレーキ信号発生手段とを含むことを特徴とする。

【０００８】この構成によれば、発電機の回転周期が設定値以上になると、運針停止用ブレーキ信号発生手段から、発電機に運針停止用のブレーキを掛ける運針停止用ブレーキ信号が出力される。すると、ブレーキ手段によって、発電機は運針停止用のブレーキ制御が行われる。

【０００９】この運針停止用のブレーキ制御は、具体的には、運針を停止あるいは非常に低速にするために、例えば発電機にブレーキを掛け続けたり、あるいは、間欠的にブレーキを掛けることで行われる。これにより、運針が停止あるいは非常に低速になるため、使用者が時刻確認のために指針を視認した際に、運針の異常を認識することができ、使用者に時刻遅れを知らせることができる。そのため、時刻遅れのまま使用者が時計を使用することを防止することができ、使用者にゼンマイを巻き上げる操作を促して電子制御式機械時計を正常動作に戻すことができる。

【００１０】また、本発明の電子制御式機械時計は、機械的エネルギ源と、前記機械的エネルギ源によって駆動される指針と、前記機械的エネルギ源によって駆動され誘起電力を発生して電気的エネルギを供給する発電機と、前記発電機にブレーキを掛けるブレーキ手段と、前記電気的エネルギにより駆動され前記ブレーキ手段を介して前記発電機の回転周期を制御する回転制御装置とを

備える電子制御式機械時計において、前記回転制御装置は、前記発電機の回転周期を検出する回転周期検出手段と、前記発電機の回転周期と基準周期とを比較する比較手段と、この比較手段によって前記回転周期が基準周期よりも早くなったことが検出されたときに前記ブレーキ手段に対して調速用ブレーキ信号を出力する調速用ブレーキ信号発生手段と、前記調速用ブレーキ信号が出力されない状態が設定時間以上継続したことを条件として、前記ブレーキ手段に対して前記発電機に運針停止用のブレーキを掛ける運針停止用ブレーキ信号を出力する運針停止用ブレーキ信号発生手段とを含むことを特徴とする。

【００１１】この構成によれば、発電機の回転周期が基準周期よりも早くなったときには、ブレーキ手段に対して調速用ブレーキ信号が出力され、調速用のブレーキ制御が行われる。従って、ゼンマイなどの機械的エネルギ源からの機械的エネルギが大きく発電機の回転周期が基準周期よりも早くなると、調速用のブレーキ制御が行われ、回転周期が基準周期に戻される。

【００１２】一方、発電機の回転周期が基準周期よりも早くない状態、つまり、ゼンマイなどの機械的エネルギ源からの機械的エネルギが小さく発電機の回転周期が基準周期よりも遅くなると、調速用のブレーキ制御は行われないため、回転周期が基準周期に戻される。

【００１３】この調速用のブレーキ制御が行われない状態、つまり、調速用ブレーキ信号が出力されない状態が設定時間以上継続すると、ブレーキ手段に対して運針停止用ブレーキ信号が出力され、運針停止用のブレーキ制御が行われる。これにより、運針が停止あるいは非常に低速になるため、使用者が時刻確認のために指針を視認した際に、運針の異常を認識することができ、使用者に時刻遅れを知らせることができる。そのため、時刻遅れのまま使用者が時計を使用することを防止することができ、使用者にゼンマイを巻き上げる操作を促して電子制御式機械時計を正常動作に戻すことができる。

【００１４】この場合、前記運針停止用ブレーキ信号発生手段は、前記調速用ブレーキ信号が出力されない状態が少なくとも２秒間以上継続したことを条件として、前記ブレーキ手段に対して前記発電機に運針停止用のブレーキを掛ける運針停止用ブレーキ信号を出力することが好ましい。

【００１５】このようにすれば、調速用ブレーキ信号が出力されない状態、つまり、調速用のブレーキ制御が行われない状態が少なくとも２秒間以上継続したことを条件として、運針停止用ブレーキ信号が出力されるから、ゼンマイなどの機械的エネルギ源からの機械的エネルギが小さくなったことを確実に検知して、運針停止用のブレーキ制御を行うことができる。なお、調速用ブレーキ信号が出力されない状態において、運針停止用のブレーキ制御を行うまでの時間は、少なくとも２秒間以上であればよく、例えば３～４秒が好ましい。

【００１６】さらに、本発明の電子制御式機械時計は、機械的エネルギ源と、前記機械的エネルギ源によって駆動される指針と、前記機械的エネルギ源によって駆動され誘起電力を発生して電気的エネルギを供給する発電機と、前記発電機にブレーキを掛けるブレーキ手段と、前記電気的エネルギにより駆動され前記ブレーキ手段を介して前記発電機の回転周期を制御する回転制御装置とを備える電子制御式機械時計において、前記回転制御装置は、前記発電機の回転周期を検出する回転周期検出手段と、前記発電機の回転周期と基準周期とを比較する比較手段と、この比較手段によって前記回転周期が基準周期よりも早くなったことが検出されたときに前記ブレーキ手段に対して調速用ブレーキ信号を出力する調速用ブレーキ信号発生手段と、前記回転周期検出手段で検出された発電機の回転周期が基準値以上の状態および前記調速用ブレーキ信号が出力されない状態のうち少なくとも１つの状態が設定時間以上継続したことを条件として、前記ブレーキ手段に対して前記発電機に運針停止用のブレーキを掛ける運針停止用ブレーキ信号を出力する運針停止用ブレーキ信号発生手段を含むことを特徴とする。

【００１７】この構成によれば、発電機の回転周期が基準値以上の状態、または、調速用ブレーキ信号が出力されない状態、さらには、これら２つの状態が設定時間以上継続したことを条件として、運針停止用ブレーキ信号が出力されるようにしたから、ゼンマイなどの機械的エネルギ源からの機械的エネルギが小さくなったことをより確実に検知して、運針停止用のブレーキ制御を正確に行うことができる。

【００１８】以上の構成において、前記運針停止用ブレーキ信号発生手段は、前記運針停止用ブレーキ信号を少なくとも２秒以上継続して出力することが好ましい。

【００１９】このようにすれば、ゼンマイなどの機械的エネルギ源からの機械的エネルギが小さくなった時点において、発電機に少なくとも２秒以上継続して運針停止用のブレーキ制御が行われるから、指針を略停止、あるいは、それに近い状態にできる。これにより、使用者が視認したとき、指針が運針しているのか、停止しているかを識別できる。なお、運針停止用のブレーキ制御を行う時間は、２秒以上であればよく、例えば、３～６秒程度が好ましい。

【００２０】また、前記運針停止用ブレーキ信号発生手段は、前記運針停止用ブレーキ信号を一定周期間隔で出力することが好ましい。

【００２１】運針停止用のブレーキ制御は、機械的エネルギ源のエネルギが低下して発電機の回転周期が基準周期よりも遅くなった際に行われるため、ブレーキ制御を行った結果、さらに発電機の回転周期が遅くなれば、ブレーキ制御を解除しても運針速度が上昇することがない。

【００２２】従って、遅針停止用のブレーキ制御を一定周期間隔で行うようにすれば、使用者が視認したとき、指針が遅針しているのか、停止しているかを識別できるとともに、使用者が指針の停止に気づいて、指針の時刻合わせ操作やゼンマイの巻き上げ操作を行う場合でも、ブレーキが解除されている期間があるため、その時刻合わせ操作や巻き上げ操作をスムーズに行うことができ、操作性を良好にできる。しかも、特別なブレーキ解除操作手段の必要ないので、コスト低減がはかれる。

【００２３】本発明の電子制御式機械時計の制御方法は、機械的エネルギ源と、前記機械的エネルギ源によって駆動される指針と、前記機械的エネルギ源によって駆動され誘起電力を発生して電気的エネルギを供給する発電機と、前記発電機にブレーキを掛けるブレーキ手段と、前記電気的エネルギにより駆動され前記ブレーキ手段を介して前記発電機の回転周期を制御する回転制御装置とを備える電子制御式機械時計の制御方法において、前記発電機の回転周期を検出し、検出された発電機の回転周期が設定値以上になったことを条件として、前記ブレーキ手段に対して前記発電機に遅針停止用のブレーキを掛ける遅針停止用ブレーキ信号を出力することを特徴とする。

【００２４】また、本発明の電子制御式機械時計の制御方法は、機械的エネルギ源と、前記機械的エネルギ源によって駆動される指針と、前記機械的エネルギ源によって駆動され誘起電力を発生して電気的エネルギを供給する発電機と、前記発電機にブレーキを掛けるブレーキ手段と、前記電気的エネルギにより駆動され前記ブレーキ手段を介して前記発電機の回転周期を制御する回転制御装置とを備える電子制御式機械時計の制御方法において、前記発電機の回転周期を検出し、検出された発電機の回転周期と基準周期とを比較して回転周期が基準周期よりも早くなったときに前記ブレーキ手段に調速用ブレーキ信号を出力するとともに、前記調速用ブレーキ信号が出力されない状態が設定時間以上継続したことを条件として、前記ブレーキ手段に対して前記発電機に遅針停止用のブレーキを掛ける遅針停止用ブレーキ信号を出力することを特徴とする。

【００２５】この場合、前記調速用ブレーキ信号が出力されない状態が少なくとも２秒間以上継続したことを条件として、前記ブレーキ手段に対して前記発電機にブレーキを掛ける遅針停止用ブレーキ信号を出力することが好ましい。

【００２６】さらに、本発明の電子制御式機械時計の制御方法は、機械的エネルギ源と、前記機械的エネルギ源によって駆動される指針と、前記機械的エネルギ源によって駆動され誘起電力を発生して電気的エネルギを供給する発電機と、前記発電機にブレーキを掛けるブレーキ手段と、前記電気的エネルギにより駆動され前記ブレーキ手段を介して前記発電機の回転周期を制御する回転制御装置とを備える電子制御式機械時計において、前記発電機の回転周期を検出し、検出された発電機の回転周期と基準周期とを比較して回転周期が基準周期よりも早くなったときに前記ブレーキ手段に調速用ブレーキ信号を出力するとともに、検出された発電機の回転周期が基準値以上の状態および前記調速用ブレーキ信号が出力されない状態のうち少なくとも１つの状態が設定時間以上継続したことを条件として、前記ブレーキ手段に対して前記発電機に遅針停止用のブレーキを掛ける遅針停止用ブレーキ信号を出力することを特徴とする。

【００２７】これらの構成によれば、上述した電子制御式機械時計で述べた効果と同じ効果、つまり、使用者が時刻確認のために指針を視認した際に、遅針の異常を認識することができ、使用者に時刻遅れを知らせることができる。そのため、時刻遅れのまま使用者が時計を使用することを防止することができ、使用者にゼンマイを巻き上げる操作を促して電子制御式機械時計を正常動作に戻すことができる。

【００２８】

【発明の実施の形態】以下に、本発明の実施形態を図面に基づいて説明する。

【００２９】（第１実施形態）図１には、本発明の第１実施形態の電子制御式機械時計を示すブロック図が示されている。

【００３０】電子制御式機械時計は、機械的エネルギ源としてのゼンマイ１と、ゼンマイ１のトルクを発電機２に伝達するエネルギ伝達装置としての増速輪列３と、増速輪列３に連結されゼンマイ１のトルクで駆動される時刻表示用の指針４とを備えている。

【００３１】発電機２は、増速輪列３を介してゼンマイ１によって駆動され、誘起電力を発生して電気的エネルギを供給する。この発電機２からの交流出力は、昇圧整流、全波整流、半波整流、トランジスタ整流等からなる整流回路５を通して昇圧、整流され、コンデンサ等で構成された電源回路６に充電供給される。

【００３２】なお、本実施形態では、図２にも示すように、整流回路５を含むブレーキ手段としてのブレーキ回路２０を発電機２に設けている。このブレーキ回路２０は、発電機２で発電された交流信号（交流電流）が入力される第１の交流入力端子ＭＧ１に接続された第１のスイッチ２１と、前記交流信号が入力される第２の交流入力端子ＭＧ２に接続された第２のスイッチ２２とを有し、これらのスイッチ２１，２２を同時にオンすることにより、第１、第２の交流入力端子ＭＧ１，ＭＧ２を短絡させて閉ループ状態にし、ショートブレーキを掛けるようになっている。

【００３３】第１のスイッチ２１は、第２の交流入力端子ＭＧ２にゲートが接続されたＰｃｈの第１の電界効果型トランジスタ（ＦＥＴ）２６と、後述するチョッパ信号発生部８-０からのチョッパ信号（チョッパパルス）Ｃ

Ｈ５がゲートに入力される第２の電界効果型トランジスタ２７とが並列に接続されて構成されている。

【００３４】第２のスイッチ２２は、第１の交流入力端子ＭＧ１にゲートが接続されたＰｃｈの第３の電界効果型トランジスタ（ＦＥＴ）２８と、チョッパ信号発生部８０からのチョッパ信号ＣＨ５がゲートに入力される第４の電界効果型トランジスタ２９とが並列に接続されて構成されている。

【００３５】発電機２に接続された昇圧用のコンデンサ２３、ダイオード２４，２５、スイッチ２１，２２を備えて倍電圧整流回路５が構成されている。なお、ダイオード２４，２５としては、一方向に電流を流す一方向性素子であればよく、その種類は問わない。特に、電子制御式機械時計では、発電機２の起電圧が小さいため、ダイオード２４，２５としては降下電圧Ｖｆや逆リーク電流が小さいショットキーバリアダイオードやシリコンダイオードを用いることが好ましい。そして、この整流回路５で整流された直流信号は、電源回路（コンデンサ）６に充電される。

【００３６】前記ブレーキ回路２０は、電源回路６から供給される電力によって駆動される回転制御装置５０により制御されている。

【００３７】回転制御装置５０は、図１にも示すように、発振回路５１、回転周期検出手段としての回転検出回路５２、制御回路５３を備えて構成されている。

【００３８】発振回路５１は時間標準源である水晶振動子５１Ａを用いて発振信号（３２７６８Ｈｚ）を出力し、この発振信号は１５段のフリップフロップからなる分周回路５４によってある一定周期まで分周される。分周回路５４の１２段目の出力Ｑ１２は、８Ｈｚの基準信号ｆｓとして出力されている。

【００３９】回転検出回路５２は、発電機２に接続された波形整形回路６１とモノマルチバイブレータ６２とで構成されている。波形整形回路６１は、アンプ、コンパレータで構成され、正弦波を矩形波に変換する。モノマルチバイブレータ６２は、ある周期以下のパルスだけを通過させるバンドパス・フィルターとして機能し、ノイズを除去した回転検出信号ＦＧ１を出力する。

【００４０】制御回路５３は、同期回路７０と、この同期回路７０を介して回転検出回路５２の回転検出信号ＦＧ１および分周回路５４からの基準信号ｆｓが入力される比較手段としてのアップダウンカウンタ６０と、調速用ブレーキ信号発生手段９０と、運針停止用ブレーキ信号発生手段１００と、チョッパ信号発生部８０とを備えている。

【００４１】同期回路７０は、４つのフリップフロップ７１、ＡＮＤゲート７２、ＮＡＮＤゲート７３からなり、分周回路５４の５段目の出力Ｑ５（１０２４Ｈｚ）や６段目の出力Ｑ６（５１２Ｈｚ）の信号を利用して、回転検出信号ＦＧ１を基準信号ｆｓ（８Ｈｚ）に同期させるとともに、これらの各信号パルスが重なって出力されないように調整している。

【００４２】アップダウンカウンタ６０は、４ビットのカウンタで構成されている。アップダウンカウンタ６０のアップカウント入力には、前記回転検出信号ＦＧ１に基づく信号が同期回路７０から入力され、ダウンカウント入力には、前記基準信号ｆｓに基づく信号が同期回路７０から入力される。これにより、基準信号ｆｓおよび回転検出信号ＦＧ１の計数と、その差の算出とが同時に行えるようになっている。

【００４３】なお、このアップダウンカウンタ６０には、４つのデータ入力端子（プリセット端子）Ａ～Ｄが設けられており、端子Ａ，Ｂ，ＤにＨレベル信号が入力されていることで、アップダウンカウンタ６０の初期プリセット値（初期カウンタ値）が「１１」に設定されている。

【００４４】また、アップダウンカウンタ６０のＬＯＡＤ入力端子には、電源回路６に接続された初期化回路９２からのシステムリセット信号ＳＲが入力されている。なお、本実施形態では、初期化回路９２は、電源回路６の充電電圧が所定電圧になるまではＨレベルの信号を出力し、所定電圧以上になればＬレベルの信号を出力するように構成されている。

【００４５】アップダウンカウンタ６０は、ＬＯＡＤ入力がＬレベルになるまで、つまりシステムリセット信号ＳＲが解除されるまでは、アップダウン入力を受け付けないため、アップダウンカウンタ６０のカウンタ値は「１１」に維持される。

【００４６】アップダウンカウンタ６０は、４ビットの出力ＱＡ～ＱＤを有している。従って、カウンタ値が「１２」以上であれば、３および４ビット目の出力ＱＣ，ＱＤは共にＨレベル信号を出力するが、カウンタ値が「１１」以下であれば、３および４ビット目の出力ＱＣ，ＱＤは共にＨレベル信号を出力することはない。これらの出力ＱＣ，ＱＤは、調速用ブレーキ信号発生手段９０に入力されている。

【００４７】なお、出力ＱＡ～ＱＤが入力されたＮＡＮＤゲート７４およびＯＲゲート７５の各出力は、前記ＮＡＮＤゲート７３にそれぞれ入力されている。従って、例えばアップカウント信号の入力が複数個続いてカウンタ値が「１５」になると、ＮＡＮＤゲート７４からはＬレベル信号が出力され、さらにアップカウント信号がＮＡＮＤゲート７３に入力されても、その入力はキャンセルされてアップダウンカウンタ６０にアップカウント信号がそれ以上入力されないように設定されている。同様に、カウンタ値が「０」になると、ＯＲゲート７５からはＬレベル信号が出力されるため、ダウンカウント信号の入力はキャンセルされる。これにより、カウンタ値が「１５」を越えて「０」になったり、「０」を越えて「１５」になったりしないように設定されている。

【００４８】調速用ブレーキ信号発生手段９０は、アップダウンカウンタ６０の出力ＱＣ，ＱＤを利用してブレーキ信号ＬＢＳ１を出力するＡＮＤゲート８６によって構成されている。つまり、アップダウンカウンタ６０のカウント値が「１２」以上ではＡＮＤゲート８６からはＨレベルのブレーキ信号ＬＢＳ１（調速用ブレーキ信号）が、カウンタ値が「１１」以下ではＡＮＤゲート８６からはＬレベルのブレーキ信号ＬＢＳ１がそれぞれ出力される。

【００４９】運針停止用ブレーキ信号発生手段１００は、前記ＡＮＤゲート８６の出力をクリア入力端子に接続したカウンタ１０１によって構成されている。カウンタ１０１のクロック入力端子には前記分周回路５４の１５段目の出力Ｑ１５（１Ｈｚ）が接続されている。従って、アップダウンカウンタ６０のカウント値が「１１」以下になると、カウンタ１０１はリセットがかからなくなり、３～４秒後に出力端子Ｑ３からＨレベルのブレーキ信号ＬＢＳ２（運針停止用ブレーキ信号）が出力され、一定周期、具体的には４秒周期でＨレベルとＬレベルとが繰り返される。なお、ブレーキ信号ＬＢＳ１、ＬＢＳ２は、共に、ＯＲゲート８７を介してチョッパ信号発生部８０に入力されている。

【００５０】チョッパ信号発生部８０は、分周回路５４の出力Ｑ５～Ｑ８を利用して第１のチョッパ信号ＣＨ１を出力するＡＮＤゲート８２と、分周回路５４の出力Ｑ５～Ｑ８を利用して第２のチョッパ信号ＣＨ２を出力するＯＲゲート８３と、前記ＯＲゲート８７の出力ＣＨ３および第２のチョッパ信号ＣＨ２が入力されるＡＮＤゲート８４と、このＡＮＤゲート８４の出力ＣＨ４と第１のチョッパ信号ＣＨ１とが入力されるＮＯＲゲート８５とを備えている。

【００５１】ＮＯＲゲート８５からの出力ＣＨ５は、Ｐｃｈトランジスタ２７，２９のゲートに入力されている。出力ＣＨ５がＬレベルとなっている間は、トランジスタ２７，２９はオン状態に維持され、発電機２がショートされてブレーキが掛かる。一方、出力ＣＨ５がＨレベルとなっている間は、トランジスタ２７，２９はオフ状態に維持され、発電機２にはブレーキが掛からない。従って、ＮＯＲゲート８５からの出力ＣＨ５によって発電機２をチョッパリング制御することができる。

【００５２】ここで、前記各チョッパ信号ＣＨ１，ＣＨ２のデューティ比は、そのチョッパ信号の１周期の間で発電機２にブレーキを掛けている時間の比率であり、本実施形態では各チョッパ信号ＣＨ１，ＣＨ２において１周期の間でＨレベルとなっている時間の比率である。例えば、各チョッパ信号ＣＨ１，ＣＨ２のデューティ比は、図３に示すように設定されている。

【００５３】いま、ＮＯＲゲート８７からの出力ＣＨ３がＬレベル信号の場合（ブレーキ信号ＬＢＳ１，ＬＢＳ２が共にＬレベルの場合）には、出力ＣＨ４もＬレベルとなる。このため、ＮＯＲゲート８５からの出力ＣＨ５は、チョッパ信号ＣＨ１が反転したチョッパ信号、つまりＨレベル期間（ブレーキオフ期間）が１５／１６と長く、Ｌレベル期間（ブレーキオン期間）が１／１６と短い、つまり弱ブレーキ制御を行うデューティ比（スイッチ２１，２２をオンしている比率）の小さな（１／１６）チョッパ信号となる。従って、発電機２に対しては、発電力を優先した弱いブレーキ制御が行われる。

【００５４】一方、ＮＯＲゲート８７からの出力ＣＨ３がＨレベル信号の場合（ブレーキ信号ＬＢＳ１，ＬＢＳ２のいずれかがＨレベルの場合）には、ＡＮＤゲート８４からはチョッパ信号ＣＨ２がそのまま出力され、出力ＣＨ４はチョッパ信号ＣＨ２と同一になる。このため、ＮＯＲゲート８５からの出力ＣＨ５は、出力ＣＨ２を反転したチョッパ信号、つまりＨレベル期間（ブレーキオフ期間）が１／１６と短く、Ｌレベル期間（ブレーキオン期間）が１５／１６と長い、つまり強ブレーキ制御を行うデューティ比の大きな（１５／１６）チョッパ信号となる。従って、出力ＣＨ５は、発電機２に対してショートブレーキを掛けるＬレベル信号のトータル時間が長くなり、発電機２に対しては強いブレーキ制御が行われるが、一定周期でＨレベル信号となってショートブレーキがオフされるためにチョッパリング制御が行われ、発電電力の低下を抑えつつ制動トルクを向上することができる。

【００５５】従って、ＮＯＲゲート８７からの出力ＣＨ３がＨレベル信号の間は、デューティ比の大きなチョッパ信号による強いブレーキ制御が行われ、Ｌレベル信号の間は、デューティ比の小さなチョッパ信号による弱いブレーキ制御が行われる。つまり、ＮＯＲゲート８７からの出力ＣＨ３によって強ブレーキ制御と弱ブレーキ制御とが切り替えられる。

【００５６】なお、本発明において、強いブレーキおよび弱いブレーキとは、相対的なものであり、強いブレーキは弱いブレーキに比べてブレーキ力が強いことを意味する。各ブレーキにおける具体的なブレーキ力つまりはチョッパブレーキ信号のデューティ比や周波数は実施にあたって適宜設定すればよい。

【００５７】次に、本実施形態における動作を図４および図５のタイミングチャートを参照して説明する。

【００５８】発電機２が作動し始めて、初期化回路９２からＬレベルのシステムリセット信号ＳＲがアップダウンカウンタ６０のＬＯＡＤ入力に入力されると、図４に示すように、回転検出信号ＦＧ１に基づくアップカウント信号と、基準信号ｆｓに基づくダウンカウント信号とがアップダウンカウンタ６０でカウントされる。これらの各信号は、同期回路７０によって同時にカウンタ６０に入力されないように設定されている。

【００５９】このため、初期カウント値が「１１」に設定されている状態から、アップカウント信号が入力され

るとカウンタ値は「１２」となり、ＡＮＤゲート８６からのブレーキ信号ＬＢＳ１がＨレベル信号となる。このとき、運針停止用ブレーキ信号発生手段１００（カウンタ１０１）の出力端Ｑ３からのブレーキ信号ＬＢＳ２はＬレベルのままであるから、ＯＲゲート８７からの出力ＣＨ３はブレーキ信号ＬＢＳ１がそのまま出力され、ブレーキ回路２０によって発電機２に対して調速用のブレーキ制御が行われる。そして、カウンタ値が「１２」以上であれば、調速用のブレーキ制御が継続される。

【００６０】逆に、ダウンカウント信号が入力されてカウンタ値が「１１」以下になると、ブレーキ信号ＬＢＳ１がＬレベルとなる。このとき、この状態が３～４秒経過するまでは、カウンタ１０１の出力端Ｑ３からのブレーキ信号ＬＢＳ２はＬレベルのままであるから、ＯＲゲート８７からの出力ＣＨ３はＬレベルである。このため、ＮＯＲゲート８５からの出力ＣＨ５は、チョッパ信号ＣＨ１が反転したチョッパ信号、つまりＨレベル期間（ブレーキオフ期間）が１５／１６と長く、Ｌレベル期間（ブレーキオン期間）が１／１６と短い、つまり弱ブレーキ制御を行うデューティ比（スイッチ２１，２２をオンしている比率）の小さな（１／１６）チョッパ信号となるため、発電機２に対しては、発電力を優先した弱いブレーキ制御が行われる。

【００６１】このように制御を行うと、図４に示すように、アップカウンタ信号とダウンカウンタ信号とが交互に入力され、カウンタ値が「１２」と「１１」とを繰り返すロック状態に移行する。この際は、カウンタ値に応じて強ブレーキ制御と弱ブレーキ制御とが繰り返される結果、発電機２は設定された回転スピード近くに維持される。

【００６２】一方、カウンタ値が「１１」以下の状態では、ブレーキ信号ＬＢＳ１がＬレベルであるから、カウンタ１０１はリセットがかからない状態にある。カウンタ１０１のクロック入力端子には、分周回路５４の１５段目の出力Ｑ１５（１Ｈｚ）が入力されているため、図５に示すように、その３～４秒後に出力端子Ｑ３からＨレベルのブレーキ信号ＬＢＳ２（運針停止用ブレーキ信号）が出力され、４秒後に停止される。その後、４秒後にブレーキ信号ＬＢＳ２（運針停止用ブレーキ信号）が出力され、これが繰り返される。このとき、ブレーキ信号ＬＢＳ１はＬレベルのままであるから、ＯＲゲート８７からの出力ＣＨ３はブレーキ信号ＬＢＳ２がそのまま出力され、ブレーキ回路２０によって発電機２に対して運針停止用のブレーキ制御が行われる。つまり、４秒間の間、運針停止用のブレーキ制御が行われ、それが４秒周期で繰り返される結果、運針が停止あるいはそれに近い状態にできるから、使用者が時刻を確認する際に運針異常を容易にかつ確実に認識することができる。

【００６３】以上の動作を図６のフローチャートで説明する。

【００６４】ステップ（以下ＳＴと略す）１において、調速用のブレーキ制御であるか否かを判断する。アップタウンカウンタ６０のカウンタ値が「１２」以上であれば、調速用ブレーキ制御を行うとともに、ＳＴ２でタイマ１（運針停止用ブレーキ信号OFF時間を計測するタイマ）およびタイマ２（運針停止用ブレーキ信号ON時間を計測するタイマ）を共にリセットし、続いて、ＳＴ３でフラグ（運針停止用ブレーキ信号のON、OFF状態を記憶するフラグ）をＦ＝０とした後、ＳＴ１へ戻る処理を繰り返す。

【００６５】ＳＴ１の判断において、アップタウンカウンタ６０のカウンタ値が「１１」以下であれば、ＳＴ４へ進みフラグＦ＝１であるか否かを判断する。フラグＦ＝１でなければ（運針停止用ブレーキ信号がOFFの状態）であれば、ＳＴ５へ進みタイマ１が３秒経過したか否かを判断する。カウンタ値が「１１」以下で、かつ、フラグＦ＝１でない状態が３秒経過すると、ＳＴ６で運針停止用ブレーキ信号を開始し、ＳＴ７でＦ＝１とし、ＳＴ８でタイマ２をスタートさせた後、ＳＴ１へ戻る。

【００６６】すると、ＳＴ４においてＦ＝１であることが認識されるから、ＳＴ９へ進みタイマ２が４秒経過したか否かを判断する。カウンタ値が「１１」以下で、かつ、フラグＦ＝１の状態が４秒経過すると、ＳＴ１０でＦ＝０、タイマ２をリセットし、ＳＴ１１でタイマ１をリセットし、ＳＴ１２で運針停止用ブレーキ信号を停止させる。その後、ＳＴ１、４～８の処理と、ＳＴ１、４、９～１２の処理とが繰り返される結果、運針停止用のブレーキ制御が周期的（４秒間隔）に繰り返される。

【００６７】このような本実施形態によれば、次のような効果がある。

【００６８】(1) 回転制御装置５０として、通常の調速用のブレーキ制御を行うための調速用ブレーキ信号発生手段９０（ＡＮＤゲート８６）のほかに、運針停止用ブレーキ信号発生手段１００を設けたので、ゼンマイ１のトルクが低下するなどして発電機２の回転周期が基準周期に比べて遅くなり、運針も遅くなって指針４の時刻表示に狂いが生じた際に、発電機２に運針停止用のブレーキ制御を行うことができる。このため、時計が正常に運針していない場合に、運針を停止あるいは非常に低速にすることができ、時計の使用者が時刻を確認する際に運針異常を容易にかつ確実に認識することができ、正しく調速された状態の電子制御式機械時計の利用を促すことができる。

【００６９】(2) 発電機２の回転周期が基準周期よりも早くなったときには、ブレーキ回路２０に対して調速用ブレーキ信号（Ｈレベルのブレーキ信号ＬＢＳ１）が出力され、調速用のブレーキ制御、つまり、強ブレーキ制御が行われる。従って、ゼンマイ１からの機械的エネルギが大きく発電機２の回転周期が基準周期よりも早くなると、調速用のブレーキ制御が行われ、回転周期が基準

周期に戻される。

【００７０】発電機２の回転周期が基準周期よりも早くない状態、つまり、ゼンマイ１からの機械的エネルギが小さく発電機２の回転周期が基準周期よりも遅くなると、弱ブレーキ制御が行われる。つまり、調速用のブレーキ制御は行われないので、回転周期が基準周期に戻される。

【００７１】このようにして、強ブレーキ制御と弱ブレーキ制御とを繰り返すことにより、発電機２を設定された回転スピード近くに維持することができる。

【００７２】(3)調速用のブレーキ制御が行われない状態が設定時間、具体的には、３～４秒以上継続すると、ブレーキ回路２０に対して運針停止用ブレーキ信号（Ｈレベルのブレーキ信号ＬＢＳ２）が出力され、運針停止用のブレーキ制御が行われる。

【００７３】従って、調速用のブレーキ制御が行われない状態が３～４秒以上継続したことを条件として、運針停止用ブレーキ制御が行われるから、ゼンマイ１からの機械的エネルギが小さくなったことを確実に検知して、運針停止用のブレーキ制御を行うことができる。

【００７４】(4)運針停止用のブレーキ制御においては、少なくとも４秒間強ブレーキ制御が行われるから、運針を確実に停止あるいはそれに近い状態にできる。従って、使用者が時刻確認のために指針を視認した際に、運針の異常を認識することができ、使用者に時刻遅れを知らせることができる。そのため、時刻遅れのまま使用者が時計を使用することを防止することができ、使用者にゼンマイ１を巻き上げる操作を促して電子制御式機械時計を正常動作に戻すことができる。

【００７５】(5)運針停止用のブレーキ制御は、ゼンマイ１のエネルギが低下して発電機２の回転周期が基準周期よりも遅くなった際に行われるため、ブレーキ制御を行った結果、さらに発電機の回転周期が遅くなれば、ブレーキ制御を解除しても運針速度が上昇することがない。

【００７６】本実施形態では、運針停止用のブレーキ制御が４秒周期間隔で行われるから、使用者が視認したとき、指針が運針しているのか、停止しているかを識別できるとともに、使用者が指針４の停止に気づいて、指針４の時刻合わせ操作やゼンマイ１の巻き上げ操作を行う場合でも、ブレーキが解除されている期間があるため、その時刻合わせ操作や巻き上げ操作をスムーズに行うことができ、操作性を良好にできる。しかも、特別なブレーキ解除操作手段の必要ないので、コスト低減がはかれる。

【００７７】(6)調速用ブレーキ制御は、カウンタ値が「１２」以上であるか、「１１」以下であるかのみで設定されるため、ブレーキ時間等を別途設定する必要もなく、回転制御装置５０をシンプルな構成にでき、部品コストや製造コストを低減でき、電子制御式機械時計を安価に提供できる。

【００７８】(7) 発電機２の回転速度に応じて、アップカウンタ信号が入力されるタイミングが変化するため、強ブレーキ制御の時間も自動的に調整することができる。このため、特にアップカウンタ信号とダウンカウント信号とが交互に入力されるロック状態では、応答性の速い安定した制御を行うことができる。

【００７９】(8)回転制御装置５０は、発電機２の両端を短絡可能なトランジスタ２７，２９を有するブレーキ回路２０を備え、トランジスタ２７，２９に矩形波パルスからなるブレーキ信号を印加してトランジスタ２７，２９をオン、オフすることで発電機２をブレーキ制御しているので、ブレーキ回路２０の構成を簡易にできコストを低減できる。

【００８０】（第２実施形態）図６には、本発明の第２実施形態の要部が示されている。なお、同図の説明にあたって、第１実施形態と同一もしくは同等の構成部分については、同一符号を付し、その説明を省略あるいは簡略化する。

【００８１】第２実施形態では、第１実施形態において、運針停止用ブレーキ信号発生手段１００が削除され、それに代わって、回転周期検出手段１１０、運針停止用ブレーキ信号発生手段１２０が設けられている。

【００８２】回転周期検出手段１１０は、前記分周回路５４の７段目の出力Ｑ７を分周する６段の分周回路１１１と、この分周回路１１１の４段目および６段目の出力Ｆ４，Ｆ６を入力とするＮＯＲゲート１１２と、このＮＯＲゲート１１２の出力をＣＫ入力端子に接続したフリップフロップ１１３と、このフリップフロップ１１３のＱ出力端子をＤ入力端に接続したフリップフロップ１１４とを備える。なお、分周回路１１１のクリア端子には、前記同期回路７０におけるＡＮＤゲート７２の出力ＦＧ２が入力されている。また、フリップフロップ１１３において、クリア入力端には同期回路７０におけるＡＮＤゲート７２の出力ＦＧ２が、Ｄ入力端にはＨレベルの信号がそれぞれ入力されている。また、フリップフロップ１１４のＣＫ入力端には前記回転検出信号ＦＧ１が入力されている。従って、発電機２の回転周期が１５６ｍｓ以上の間はＳＰ１がＬレベルであるが、発電機２の回転周期が１５６ｍｓ未満ではＳＰ１がＨレベルとなる。

【００８３】運針停止用ブレーキ信号発生手段１２０は、前記フリップフロップ１１４の反転出力をクリア入力端子に接続したカウンタ１２１と、このカウンタ１２１の出力端子Ｑ３をＣＫ入力端子に接続したフリップフロップ１２２と、前記カウンタ１２１の出力端子Ｑ３からの出力およびフリップフロップ１２２の反転出力を入力とするＡＮＤゲート１２３とを備える。なお、カウンタ１２１のクロック入力端子には前記分周回路５４の出力Ｑ１５からの出力（１Ｈｚ）が入力されている。ま

た、フリップフロップ１２２のＣＲ反転入力端子には前記フリップフロップ１１４の出力ＳＰ１が、Ｄ入力端にはＨレベルの信号がぞれぞれ入力されている。

【００８４】従って、発電機２の回転周期が１５６ｍｓ未満ではＳＰ１がＨレベルであるから、カウンタ１２１はリセットされ、出力端子Ｑ３からＨレベルの信号が出力されない。

【００８５】しかし、発電機２の回転周期が１５６ｍｓ以上になると、図８に示すように、ＳＰ１がＬレベルとなり、カウンタ１２１はリセットがかからない状態になる。すると、カウンタ１２１のクロック入力端子には、分周回路５４の１５段目の出力Ｑ１５（１Ｈｚ）が入力されているため、その３～４秒後に出力端子Ｑ３からＨレベルのブレーキ信号ＬＢＳ２（運針停止用ブレーキ信号）が４秒周期で出力される。その結果、ブレーキ信号ＬＢＳ３は最初のＨレベルのブレーキ信号ＬＢＳ２に対応した期間（４秒）だけＨレベルとなる。このブレーキ信号ＬＢＳ３がＯＲゲート８７を通じて出力されるため、ブレーキ回路２０によって発電機２に対して運針停止用のブレーキ制御が行われる。つまり、４秒間の間だけ、運針停止用のブレーキ制御が行われる。これによって、使用者が時刻を確認する際に運針異常を容易にかつ確実に認識させることができる。

【００８６】以上の動作を図９のフローチャートで説明する。

【００８７】図９のフローチャートでは、ロータ回転周期検出のステップＳＴ１３が付加されている点、ＳＴ１の判断において、その回転周期が１５６ｍｓより大きいか否かを判断している点が、図６のフローチャートとは異なる。

【００８８】この場合には、回転周期が１５６ｍｓより大きい状態では、ＳＴ４へ進み運針停止用のブレーキ制御が行われるようになっている。

【００８９】このような実施形態によれば、次のような効果がある。

【００９０】(9) 回転周期検出手段１１０によって発電機２の回転周期が１５６ｍｓより大きいことが検出されると、運針停止用ブレーキ信号発生手段１２０のカウンタ１２１はリセットがかからない状態となり、その状態が３～４秒継続すると、カウンタ１２１の出力端子Ｑ３からのブレーキ信号ＬＢＳ２がＬレベルからＨレベルに変わる。すると、ブレーキ信号ＬＢＳ３は最初のＨレベルのブレーキ信号ＬＢＳ２に対応した期間（４秒）だけＨレベルとなるから、つまり、４秒間の間だけ、運針停止用のブレーキ制御が行われるため、使用者が時刻を確認する際に運針異常を容易にかつ確実に認識することができる。

【００９１】（第３実施形態）図１０には、本発明の第３実施形態の要部が示されている。なお、同図の説明にあたって、第２実施形態と同一もしくは同等の構成部分については、同一符号を付し、その説明を省略あるいは簡略化する。

【００９２】第３実施形態は、第２実施形態に対して、運針停止用ブレーキ信号発生手段が異なる。本実施形態における運針停止用ブレーキ信号発生手段１２０には、前記回転周期検出手段１１０からの出力ＳＰ１と、前記ＡＮＤゲート８６からのブレーキ信号ＬＢＳ１とを入力とし、出力を前記カウンタ１２１のクリア入力端子に接続したＡＮＤゲート１２４が付加されている。

【００９３】この実施形態では、図１１に示すフローチャートのように、ＳＴ１がNOで、かつ、ＳＴ１３がYESのときのみ、つまり、発電機２の回転周期が１５６ｍｓ以下で、かつ、アップダウンカウンタ６０のカウンタ値が「１２」以上のときのみ、調速用ブレーキ制御が行われ、それ以外のときは、ＳＴ５～ＳＴ１２の処理によって運針停止用のブレーキ制御が行われるようになっている。

【００９４】このような実施形態によれば、次のような効果がある。

【００９５】(10) 回転周期検出手段１１０で検出された発電機２の回転周期が１５６ｍｓ以下で、かつ、アップダウンカウンタ６０のカウンタ値が「１２」以上の状態のときには、運針停止用ブレーキ信号発生手段１２０のカウンタ１２１はリセットがかかり、それ以外の条件のとき、つまり、①発電機２の回転周期が１５６ｍｓより大きいとき、②アップダウンカウンタ６０のカウンタ値が「１１」以下のとき（調速用ブレーキ信号が出力されない状態のとき）、③同時に①②の状態になったときには、運針停止用ブレーキ信号発生手段１２０のカウンタ１２１はリセットがかからない状態となるから、その３～４秒に４秒間の間でけ、運針停止用のブレーキ制御が行われる。この場合、①および②の状態を監視して、運針停止用のブレーキ制御を行うようにしているから、運針異常を容易にかつ確実に検出できる。

【００９６】なお、本発明は前記実施形態に限定されるものではなく、本発明の目的を達成できる範囲での変形、改良等は、本発明に含まれるものである。

【００９７】前記実施形態では、４ビットのアップダウンカウンタ６０を用いていたが、３ビット以下のアップダウンカウンタを用いてもよいし、５ビット以上のアップダウンカウンタを用いてもよい。

【００９８】また、ブレーキ回路２０、同期回路７０等の具体的な構成は前記各実施形態のものに限らず、実施にあたって適宜設定すればよい。

【００９９】さらに、前記実施形態では、運針停止用ブレーキ制御時に４秒間隔でブレーキをオン、オフしていたが、このブレーキを掛ける設定時間は、時計の機械的負荷やゼンマイのトルクなどを考慮して適宜設定すればよく、例えば２～６秒程度に設定してもよい。

【０１００】また、本発明は、前記実施形態のような電

子制御式機械時計に適用するものに限らず、置き時計、クロック等の各種時計、携帯型時計、携帯型の血圧計、携帯電話、ページャ、万歩計、電卓、携帯型パーソナルコンピュータ、電子手帳、携帯ラジオ、オルゴール、メトロノーム、電気かみそり等にも適用することができる。

【０１０１】

【発明の効果】以上に述べたように、本発明の電子制御式機械時計およびその制御方法によれば、使用者に時刻遅れを知らせることができ、時刻遅れのまま使用者が時計を使用することを防止することができる。

【図面の簡単な説明】

【図１】本発明の第１実施形態における電子制御式機械時計の要部の構成を示すブロック図である。

【図２】第１実施形態の電子制御式機械時計の構成を示す回路図である。

【図３】第１実施形態のチョッパ制御部の動作を示すタイミングチャートである。

【図４】第１実施形態において、通常時の制御タイミングを示すタイミングチャートである。

【図５】第１実施形態において、低速回転時の制御タイミングを示すタイミングチャートである。

【図６】第１実施形態の動作を示すフローチャートである。

【図７】本発明の第２実施形態の要部を示す回路図である。

【図８】第２実施形態において、低速回転時の制御タイミングを示すタイミングチャートである。

【図９】第２実施形態の動作を示すフローチャートである。

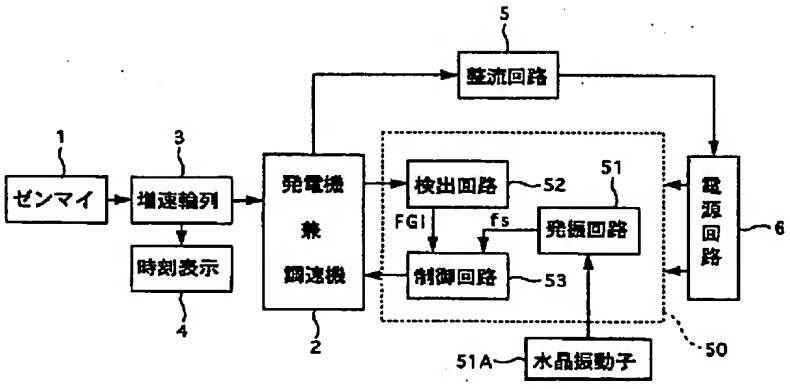
【図１０】本発明の第３実施形態の要部を示す回路図である。

【図１１】第３実施形態の動作を示すフローチャートである。

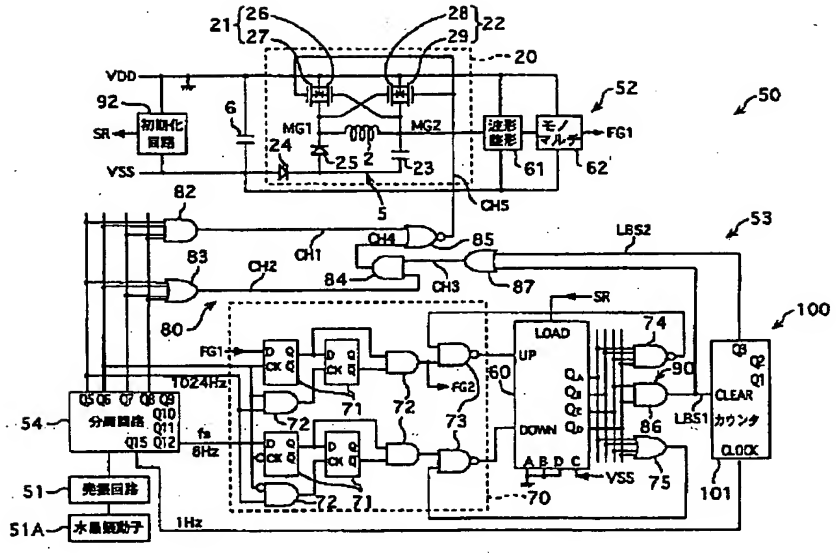
【符号の説明】

１　ゼンマイ（機械的エネルギ源）
２　発電機
４　指針
５　倍電圧整流回路
６　電源回路
２０　ブレーキ回路（ブレーキ手段）
５０　回転制御装置
５２　回転検出回路（回転周期検出手段）
６０　アップダウンカウンタ（比較手段）
７０　同期回路
８０　チョッパ信号発生部
９０　調速用ブレーキ信号発生手段
１００　運針停止用ブレーキ信号発生手段
１１０　回転周期検出手段
１２０　運針停止用ブレーキ信号発生手段

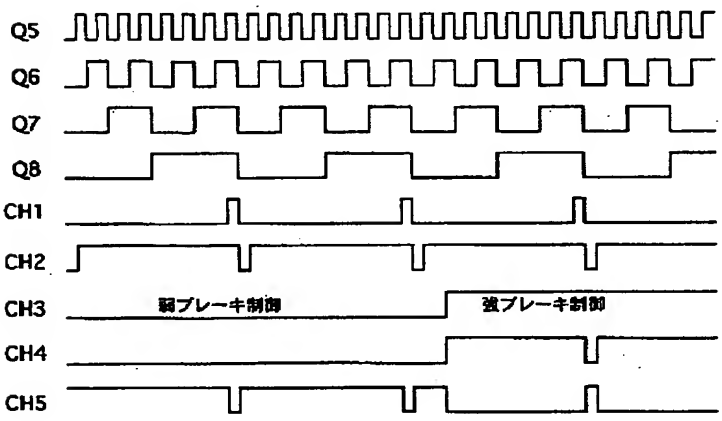
【図１】



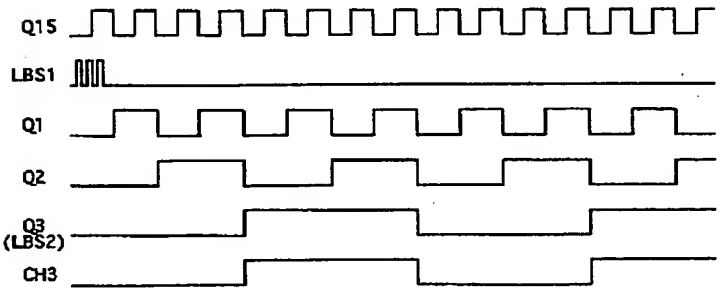
【図２】


21
26
27
28
29
22
20
VDD
92
SR
初期化回路
6
MG1
MG2
24
25
2
23
5
CH5
波形整形
モノマルチ
FG1
52
50
61
62
VSS
82
83
CH1
CH2
84
CH4
85
CH3
87
LBS2
53
SR
80
FG1
1024Hz
54
Q5 Q6 Q7 Q8 Q9 Q10 Q11 Q15 Q12
分周回路
fs
8Hz
71
72
73
FG2
60
LOAD
UP
DOWN
A B D C
VSS
70
74
90
86
75
CLEAR
カウンタ
CLOCK
LBS1
101
100
51
発振回路
51A
水晶振動子
1Hz

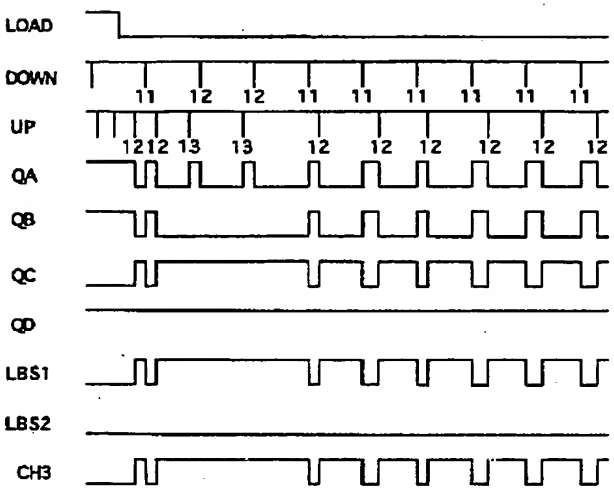
【図３】


Q5
Q6
Q7
Q8
CH1
CH2
CH3
弱ブレーキ制御
強ブレーキ制御
CH4
CH5

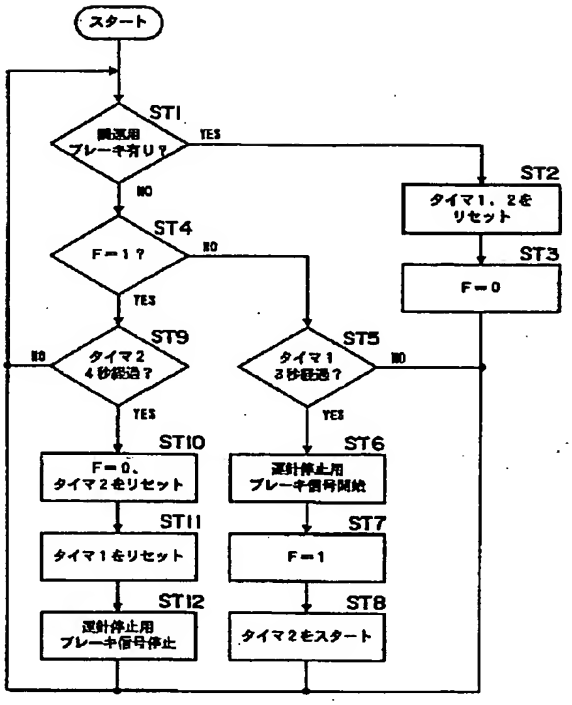
【図５】


Q15
LBS1
Q1
Q2
Q3
(LBS2)
CH3

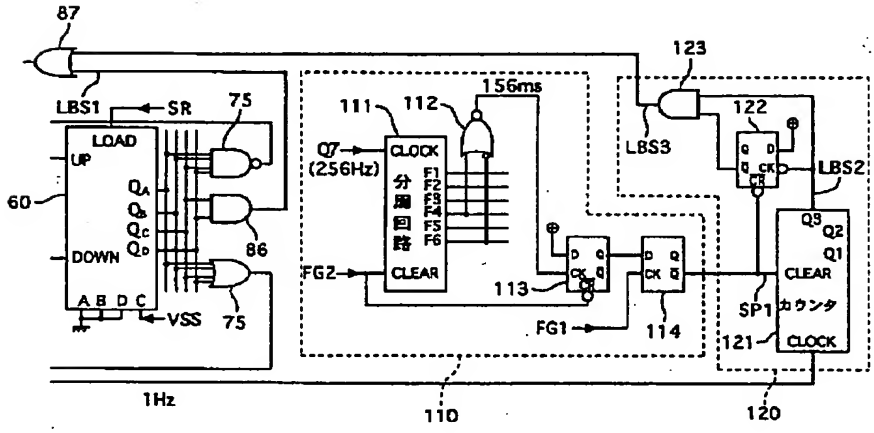
【図４】


LOAD
DOWN
UP
QA
QB
QC
QD
LBS1
LBS2
CH3
11 12 12 11 11 11 11 11 11
12 12 13 13 12 12 12 12 12 12

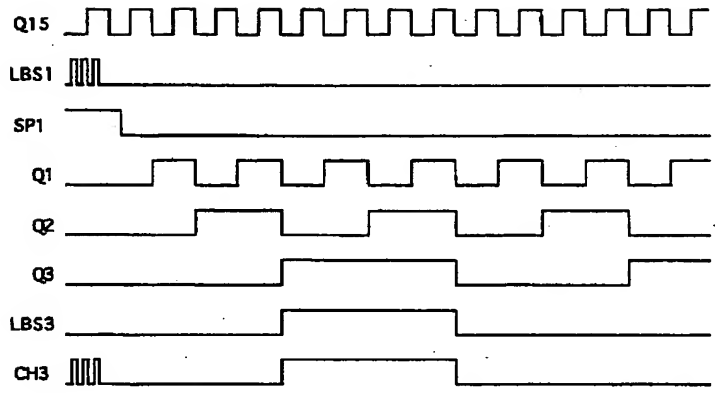
【図６】


スタート
ST1
YES
NO
ST2
タイマ1，2を
リセット
ST3
F＝0
ST4
F＝1？
NO
YES
ST9
タイマ2
4秒経過？
NO
YES
ST5
タイマ1
3秒経過？
NO
YES
ST10
F＝0、
タイマ2をリセット
ST11
タイマ1をリセット
ST12
運針停止用
ブレーキ信号停止
ST6
運針停止用
ブレーキ信号開始
ST7
F＝1
ST8
タイマ2をスタート

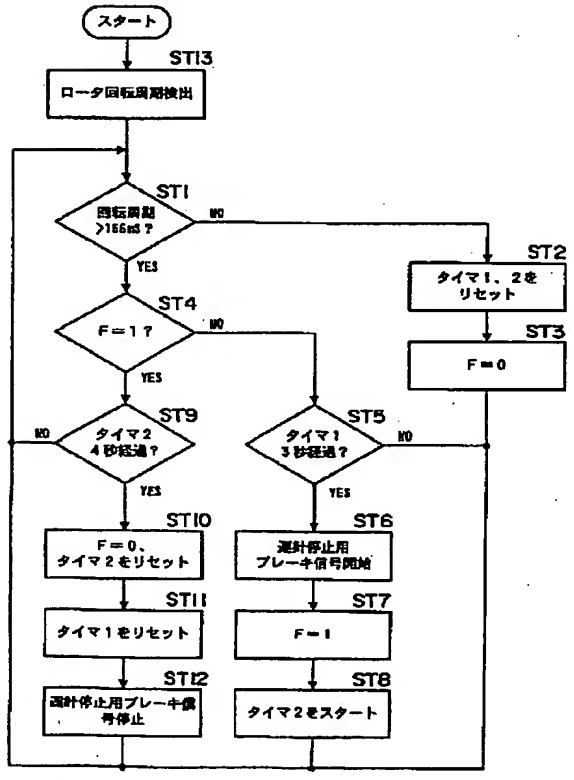
【図７】


87
123
LBS1
SR
75
111
112
156ms
122
LBS3
LBS2
LOAD
UP
60
DOWN
A B D C
VSS
75
86
Q7
(256Hz)
CLOCK
分周回路
F1
F2
F3
F4
F5
F6
CLEAR
FG2
113
FG1
114
SP1
121
Q3
Q2
Q1
CLEAR
カウンタ
CLOCK
1Hz
110
120

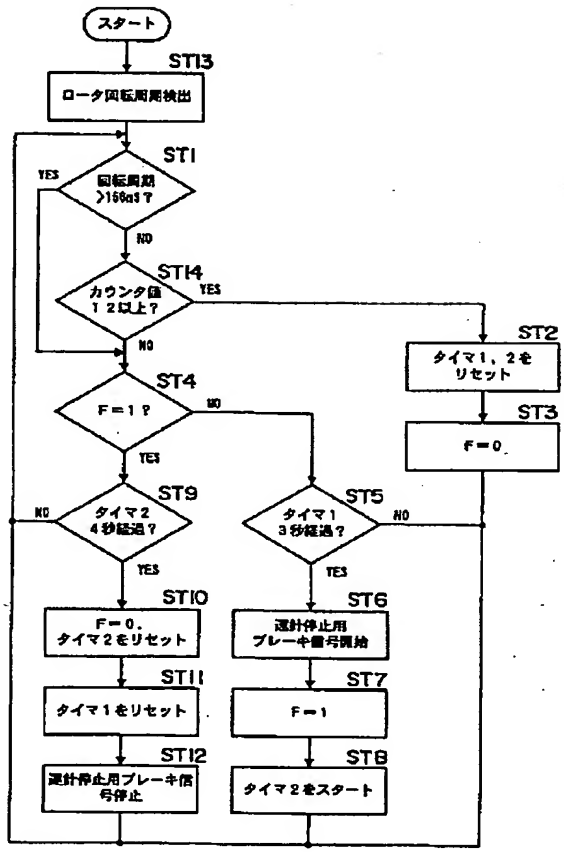
【図８】


Q15
LBS1
SP1
Q1
Q2
Q3
LBS3
CH3

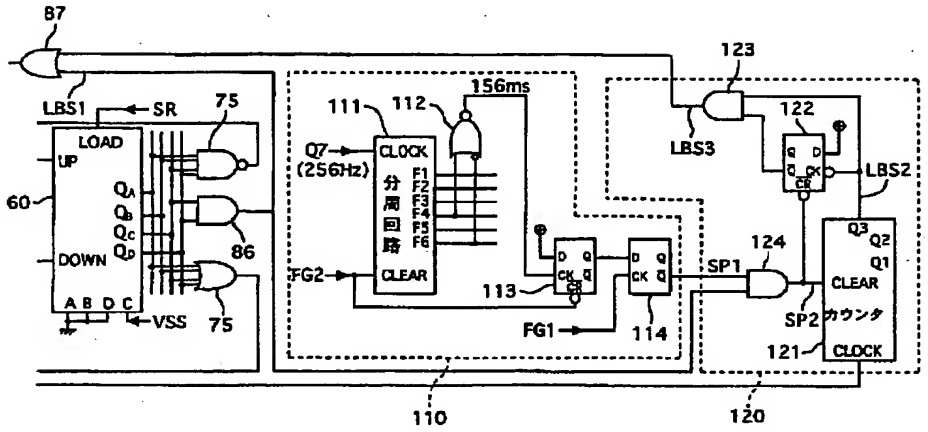
【図９】


スタート
ST13
ロータ回転周期検出
ST1
回転周期 >166ms？
NO
YES
ST2
タイマ１、２を リセット
ST3
F＝0
ST4
F＝１？
NO
YES
ST9
タイマ２ ４秒経過？
NO
YES
ST5
タイマ１ ３秒経過？
NO
YES
ST10
F＝0、 タイマ２をリセット
ST6
遅針停止用 ブレーキ信号開始
ST11
タイマ１をリセット
ST7
F＝１
ST12
遅針停止用ブレーキ信号停止
ST8
タイマ２をスタート

【図１１】


スタート
ST13
ロータ回転周期検出
ST1
YES
回転周期 >166ms？
NO
ST14
カウンタ値 １２以上？
YES
NO
ST2
タイマ１、２を リセット
ST3
F＝0
ST4
F＝１？
NO
YES
ST9
タイマ２ ４秒経過？
NO
YES
ST5
タイマ１ ３秒経過？
NO
YES
ST10
F＝0、 タイマ２をリセット
ST6
遅針停止用 ブレーキ信号開始
ST11
タイマ１をリセット
ST7
F＝１
ST12
遅針停止用ブレーキ信号停止
ST8
タイマ２をスタート

【図１０】



フロントページの続き

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Ｆターム(参考)　2F082 AA00 CC01 CC06 CC10 DD08 DD09 DD10 HH00 HH01 JJ00
5H590 AA04 AA21 AB15 CA30 CC02 CC22 CD01 CE10 EA05 EA13 EA20 FB01 FC12 FC14 FC22 FC26 GB04 HA11 HA27 JA02 JA09 JA19 JB01 JB03 JB12 JB15 JB18 KK01